Understanding Institutional Arrangements for Community-Based Natural Resource Management in the Mekong Delta of Cambodia and Vietnam

– A mixed methods approach –

Inaugural - Dissertation

zur

Erlangung der wirtschaftswissenschaftlichen

Doktorwürde

des

Fachbereichs Wirtschaftswissenschaften

der Philipps-Universität Marburg

vorgelegt von

Christine Werthmann

Wissenschaftliche Mitarbeiterin aus Darmstadt

Marburg

2011

Druck von: Verlag Dr. Hut, München

Als Dissertation vom Fachbereich Wirtschaftswissenschaften angenommen am:
21. Juli 2011

Berichterstatter: Prof. Dr. Michael Kirk
Mitberichterstatter: Prof. Dr. Wolfgang Kerber

Tag der mündlichen Prüfung: 18. August 2011

Acknowledgements

First and foremost, I would like to thank Professor Michael Kirk to have given me the opportunity to realise this research under his supervision. His teaching during my MSc studies in Marburg wakened my curiosity in the world of new institutional economics, common-pool resources and common dilemmas and I am grateful that I had the opportunity to explore this world on my own. Professor Kirk did not only give the most valuable suggestions for this research, but also supported me in every other possible way and motivated me to finalise this project. Many thanks as well to my co-advisor Professor Wolfgang Kerber for taking his time to carefully read the dissertation and for his valuable suggestions for improving it. Dr. Natasja Sheriff, the project leader of the WorldFish project, acted as my supervisor during this research. I would like to thank her for all the efforts she made to support me, that were far more than anyone could expect. Her comments to this piece of writing, her support in administrative and managerial aspects of my work in Asia as well as her initiative on including me in the project as an acknowledged research fellow are very much appreciated. I also thank her for her friendship. I very much enjoyed the times we have spent together during the different research phases.

Further, I would like to thank all my colleagues at the Institute for Co-operation in Developing Countries in Marburg, Germany. I would like to express warm thanks to Dr. Björn Vollan who gave not only valuable comments to earlier versions of the dissertation, but also supported me during the whole time of this research with advice and friendship. Also, Anne Weingart, with whom I have spent long days and nights in the field, deserves warm thanks for her constructive and hard work in Cambodia. I further very much appreciate the opportunity to participate in the PhD School at the University Freiburg and the Walter-Eucken-Institute in 2007 and would like to thank Professor Lin Ostrom and Professor Achim Schlüter as well as my colleagues from this summer school for many interesting discussions. Further thanks go to the organisers and participants from the IASC Conference in Cheltenham in 2008, the Mannheim Empirical Research School in 2009 as well as to Professor Konrad Hagedorn and his colleagues who shared their views about my topic during the PhD colloquium at the Department of Resource Economics at the Humboldt University of Berlin. A warm thanks deserves Dr. Harald Kolbe for providing comments to this research.

In Cambodia, I received incredible support from everyone at the WorldFish Regional Office. Special thanks to Dr. Blake Ratner for accommodating me at the Regional Office. I always felt comfortable and supported. I would like to thank Dr. Robert Arthur for sharing his knowledge about social research and fisheries as well as for his support in regard to project implementation. I further would like to thank Dr. Eric Baran for sharing his knowledge about Cambodian fisheries with me. Warm thanks go to Thida and Sereyroth for their great support concerning administrative issues and to Dr. Francis Murray, who acted as my supervisor in the first six months and supported me very much during the development of the research proposal.

Further, I would like to thank the FiA in Cambodia that supported the project implementation and thus my research. Pich Sereywath and Heng Kong worked hard to make this project a success and I would like to thank both of them for all their efforts they invested. Also at RIA2 in Vietnam, I received support that was of incredible value for me. Dr. Nguyen Hao accommodated me at RIA2 and supported my research in every possible way. His team is great and without them, my research would not have been possible. I would like to express special thanks to Mai Thi Truc Chi for her hard work. Her facilitation work and way of solving problems in the field was very much appreciated. I also would like to thank her for her friendship. Warm thanks go to Hong and Tung as well as Ngai and Minh.

Of incredible importance was the hard work my field team in Cambodia invested in my research. Special thanks go to So Khansom. She did a wonderful job and I appreciate her patience and the motivation she has put into our (sometimes exhausting) field trips. Further, I would like to thank all students that acted as enumerators during my research. They worked hard during the survey implementation, but never lost their sense of humour. Also, the teams of CARE Cambodia and CCK deserve a warm thank you. Joseph K, Pun, Dara and Philip shared their knowledge about Cambodia and the villages I was working in with great patience and always made my stay in the field very much productive and comfortable. Thank you.

The field research to this PhD was funded by CAPRi and would not have been possible without the financial support. However, I also would like to thank the staff from IFPRI and CAPRi who gave me valuable feedback and support. I thank Bing Rowena Valmonte-Santos for sharing her field experience with me and in supporting me in every possible way during her stays in the field. Many thanks go also to Professor Ruth Meinzen-Dick for the incredible valuable telephone conferences about my research and the project in general. Further, I would like to thank Stephan Dorn and Helen Markelova for their administrative support.

I would like to express my sincere thanks to all farmers in the Cambodian and Vietnamese villages I have worked in. Without their dedication and patience to answer my questions and to participate in the research, this thesis would not have been possible. I appreciate very much that they have invited me to share their lives and that they actively aimed at overcoming cultural borders. There is no expression for the value this has given to this work as well as to me personally. Thank you very much.

Finally, I would like to thank my family and friends that have supported me during the whole time of this dissertation. These include especially my friends in Cambodia and Vietnam and those I have shared my time with in Asia. Special thank goes to Ralph Fricke whose love and support gave me the necessary motivation to finalise this project.

Christine Werthmann, Berlin, October 2011

Abstract

In the Mekong Delta of Cambodia and Vietnam, property rights on water and land change with the seasonally occurring flood. Land is usually cultivated on an individual basis with people holding at least private use rights to the parcels. In contrast, water is a public good and as soon as water covers the individual plots, the streams, lakes and reservoirs are legally accessed by many households using the water for many different purposes. Actually, during wet season, an *open access* to the water resources is found as the water use is not restricted, meaning that de facto there are no rules in place that govern the water use.

This thesis focuses on the institutional arrangements that influence the management of land, water and fisheries in the region. It is assessed how property rights influence the natural resource use and how collective action can contribute to the sustainable management of land and water. The research was conducted in a community-based fish culture project that functions as a reference frame. This aquaculture project was implemented in the Mekong region by the WorldFish Center from 2005 until 2010. The aim was to test, whether community-based aquaculture can increase the food security of local communities. The thesis also addresses the question whether such a community-based approach can be successfully introduced in the described complex system of property rights.

The underlying theories for this dissertation are New Institutional Economics and Game theory. As a framework for the analysis the *Institutional Analysis and Design Framework* (Ostrom 2005b) is used. Further, the dissertation draws upon findings from other scholars in the realm of public goods and common-pool resources. The research uses as a *mixed methods approach* and contains qualitative as well as quantitative results. In four case study sites, action research was conducted along with the aquaculture project implementation. Further, a socio-economic survey was implemented, providing information about different livelihood aspects of a large amount of households. Based on the findings of both these methods, hypotheses in regard to resource users' behaviour towards natural resources were elaborated. Those were then tested using the methods of experimental economics.

The implementation of the community-based project faced several challenges and the pilot phase was discontinued by most of the villages. The results presented in this thesis show that reasons for this cannot be seen in the low willingness for cooperation of participants, but rather in the underlying property rights on natural resources. Due to a missing legal base as well as other informal regulations, the project members had no possibility to exclude other local users from the project sites and thus to protect their investments in material and fingerlings. Recommendations mainly focus on the decentralisation of land and water management in the region.

Table of Contents

List of tables

List of figures

Abbreviations

Adj.	Adjusted
CAS	Center of ASEAN Studies
CBFC	Community-based fish culture
CCK	Chamroe Chiet Khmer Organisation
CDRI	Cambodia Development Resource Institute
CGIAR	Consultative Group on International Agricultural Research
CIA	Central Intelligence Agency
cm	centimetre
CPR(s)	Common-pool resource(s)
CP35	Challenge-Program No. 35
CPWF	Challenge Program on Water and Food
DARD	Department of Agricultural and Rural Development (Vietnam)
df	Degrees of freedom
E2	E2 hamlet (Vietnam)
e.g.	for example (lat. "exempli gratia")
FAO	Food and Agricultural Organisation
FiA	Fishery Administration (Cambodia)
FWUC	Farmer Water User Community
FWUG	Farmer Water User Group
GDP	Gross Domestic Product
ha	hectare
HDI	Human Development Index
HH(s)	HH(s)
HHH	Household head
HL Chi^2	Hosmer-Lemeshow Chi^2 specification test
hrs	hours
IE	Institutional Economics
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Center
kg	kilogram
km	kilometre
km^2	square kilometre
LR	Likelihood-ratio test
LMAP	Land Management and Administration Project (Cambodia)
m	metre
m^2	square metre
m^3/s	cubic metre per second
MLMUPC	Ministry of Land Management, Urban Planning and Construction (Cambodia)
MoF	Ministry of Fisheries (Vietnam)
MOWRAM	Ministry of Water Resources and Meteorology (Cambodia)
MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
NARES	National Aquatic Research and Extension Systems
NIE	New Institutional Economics
NIS	National Institute of Statistics
NGO(s)	Non-Governmental Organisation(s)
OLS	Ordinary Least Square
PAPD	Participatory Action Planning Development Methodology
PC	People's Committee (Vietnam)
PD	Prisoner's Dilemma
PE	Pom Eith village (Cambodia)
PG(s)	Public good(s)
PRA	Participatory Rural Appraisal

RESET Test	Ramsey Regression Equation Specification Error Test
RGC	Royal Government of Cambodia
RIA2	Research Institute for Aquaculture No.2 (Vietnam)
S.E.	Standard Error of Regression Coefficient
SRV	Socialist Republic of Vietnam
std. dev.	standard deviation
TK	Thnal Kaeng village (Cambodia)
TPB	Truong Phu B hamlet (Vietnam)
UNDP	United Nations Development Programme
US$	US Dollar
VND	Vietnamese Dong
WorldFish	The WorldFish Center

1 Introduction

This research was undertaken in communities in the Lower Mekong Basin of Cambodia and Vietnam with rural households (HHs) engaging in subsistence or small-scale fishing (family fishing) on part or full-time basis. People in these communities engage in rice culture seasonally and fish in the adjacent rice fields and in reservoirs, rivers and canals during the whole year.

The aim of the research is to assess the impact of underlying institutional arrangements on the management of water and land. Further, it aims to find out what institutions are required to achieve successful collective action for community-based natural resource management in the region. The research was conducted along with a community-based fish culture (CBFC) project implemented by The WorldFish Center (WorldFish). Thus, the research also addresses the question whether such a community-based approach to aquaculture can provided sustained benefits to the people in the Mekong Delta.

Farmers and fishermen in the area draw upon a range of strategies for claiming and obtaining access to water and land for rice cultivation or fishing activities. Formal and informal institutions including historical developments, seasonal change in property rights and on-going decentralisation efforts in both countries influence the management of local natural resources today. Although in the last decades, both countries developed respective laws to govern the use of land, water and fisheries, local rights to access to and use of the resources might also depend on other (informal) institutions (e.g. traditional and customary rights, unwritten local norms). These might also differ from community to community. Further, in Cambodia, property rights on local levels might not yet be officially granted to some of the individual parcels. The resource users often face uncertainty about future availability of the resources and the possibility to profit from their benefits. These factors all influence the management and the sustainable use of land and water. An analysis about institutional arrangements in regard to who receives water, from which resource, for what purpose and who gains access to what parcel of land, was thus the first step to be completed within this research.

The formal institutions that govern the access to natural resources in both countries will be presented in this first section. Further, the challenges the governance of natural resources in the Delta is facing are emphasised. In a second section the CBFC project with its objectives will be introduced as it is used as a reference frame in this research. The third section introduces the research issues, questions and the methodology of this dissertation. Justification and limitations are given in the fourth section. The last section summarises the introduction and provides an outline of the dissertation.

1.1 Cambodia and Vietnam: Natural resources and their governance

The Kingdom of Cambodia and the Socialist Republic of Vietnam (SRV) are situated in South East Asia with a population of 14 million and 85 million respectively.[1] The United Nations Human Development Index (HDI) 2009 ranks Cambodia 137 out of 182 countries with a Gross Domestic Product (GDP) per capita of 1,802 US$. In 2009, 35 percent of the Cambodian population lived below the national poverty line. However, poverty declined in the last decades as in 1995 more than 47 percent of the Cambodians were living in poverty. Vietnam is ranked 116 out of 182 countries and has a per capita GDP of 2,600 US$ in 2009. In Vietnam, 20 percent of the population lives below the national poverty line, which represents a dramatic decrease of poverty in the country from 58 percent in 1993 (UNDP 2007; UNDP 2008a; UNDP 2008b; UNDP 2008c; 2009). Both Southeast-Asian countries are overwhelming rural societies with 81 percent of the Cambodians and 74 percent of the Vietnamese living in rural areas deriving their livelihoods mainly from rice production and fishing activities (FAO 2006a; 2006b).

In both countries, more than 65 percent of the total labour force is engaged in agriculture. The agricultural sector still accounts for 32.9 percent in Cambodia and 21.8 percent in Vietnam of the total GDPs. Rice production is the main activity in agriculture besides meat, rubber and vegetable production (FAO 2006a; 2006b). Cambodia ranks 15, Vietnam five in the world's rice/paddy producers (FAO 2009c). Further, fishing contributes significantly to food security and livelihoods of people living in the Lower Mekong Delta. In Cambodia, six million people (almost 50 percent of the population) are employed full- or part-time in fisheries (FAO 2009a; 2009b).[2] Although not commercially significant, the catch of the small-scale and rice field fishers is of high socio-economic importance as most output from those activities is directly consumed by the fishing family, with only the surplus sold for some cash (FAO 2009a; 2009b).[3] In Vietnam, nine million people representing more than ten percent of the total population are engaged in part- or full-time fishing activities (FAO 2009a; 2009b).

In regard to the importance of agriculture and fisheries to Cambodian and Vietnamese livelihoods, it is alarming that the fisheries and water resources actually face severe socio-economic and natural challenges. Multiple developments can be identified that put a threat on the Mekong fisheries. Besides population pressure, that will lead to an increase in catch, the modification of natural flows (due to

[1] Cambodia is mostly landlocked with a small coastline of 440 km at the Gulf of Thailand in the South (NIS Cambodia 2005). Cambodia borders Thailand to the west and northwest, Vietnam to its east and southeast and Laos to the north. The total land area of Cambodia is 181,035 km^2 and is divided into 20 administrative provinces and four municipalities. Vietnam is the easternmost country on the Indochina Peninsular and shares a border with China in the north, Laos in the northwest and Cambodia in the east. The east border to the South China Sea has a length of 3,260 km (see also Figure 1). The total land area of Vietnam covers 331,690 km^2 (CIA 2009).

[2] BARAN ET AL. state that 10.5 percent of the HHs in Cambodia have fishing or a fishing related activity as the primary occupation while another 34.1 percent are engaged on a part-time basis (Baran et al. 2007).

[3] THOUK ET AL. (1996) state that overall 88 percent of the Cambodians rely on natural fishing and fishing related activities (Thouk et al.1996).

dikes, road networks, small and large dams), illegal fishing activities and increased sediment loads following deforestation occur (Sverdrup-Jensen 2002). These and other factors have led to a fragmentation of aquatic habitats and the blocking-off of fish spawning areas. Flow modification on a national and international level and broader development threaten to disrupt the livelihoods of those who strongly depend on the aquatic resources, especially as fishing is essentially providing a resort of security for the poorest (Sverdrup-Jensen 2002; Baran 2005). Small-scale fishermen harvest the bulk of all fish consumed in Cambodia and Vietnam and they represent the people mostly affected by a declining fish stock due to natural and man-made changes in the natural system of the Mekong Basin.

1.1.1 Fisheries in the Mekong Delta

The Mekong River is one of the largest rivers in the world with a length of 4,800 km (MRC 2009). The river flows through six countries before reaching the South China Sea (Figure 1). During the rainy season the surface of the Mekong wetlands covers 19 percent of the total surface of Cambodia and 12 percent of Vietnam (Scott 1989; Lacoursiere et al. 1998; Baran 2005). Due to its flow patterns, the Mekong River is providing millions of hectares of permanent waters, flooded forests and grasslands, receding and floating rice fields, seasonally flooded crop fields and swamps (Ahmed et al. 1998; van Zalinge et al. 2000).

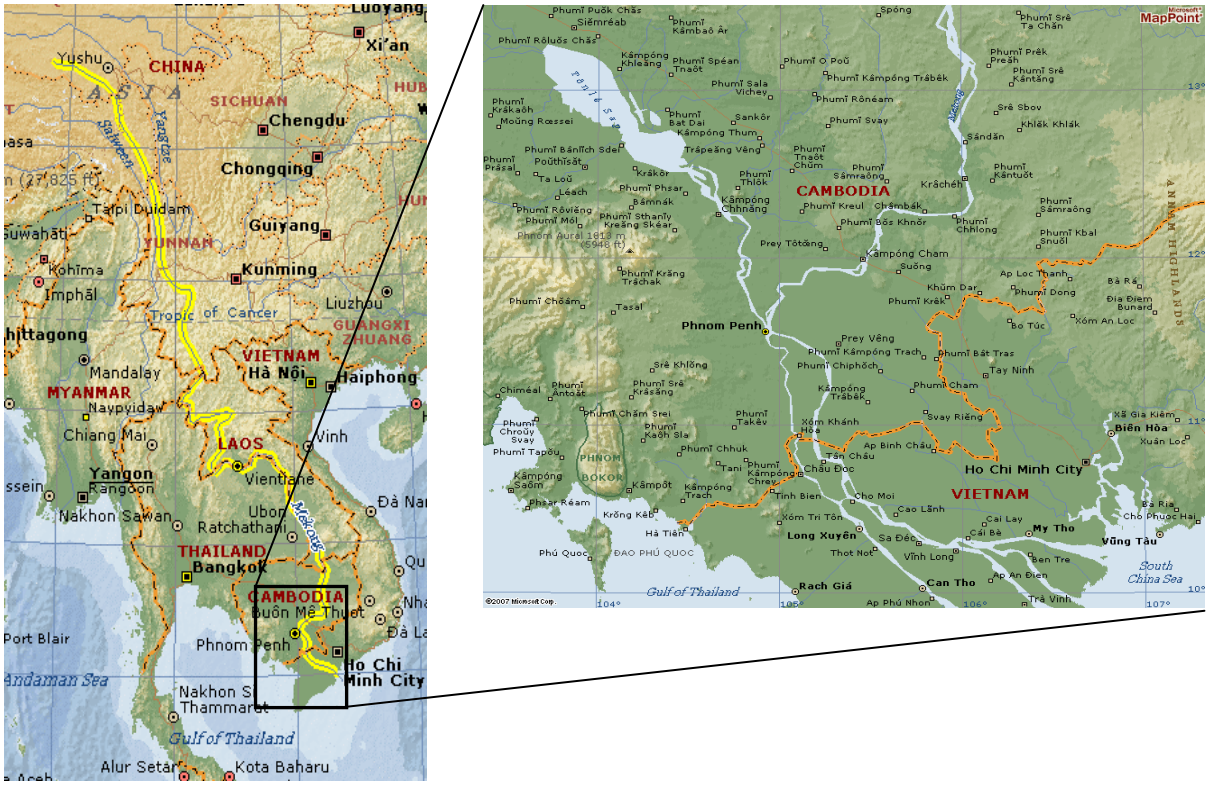

Figure 1: The countries of the Mekong and the Mekong Basin in Cambodia and Vietnam (Source: MSN Encarta 2009)

In possession of these natural resources, it is not surprising that Cambodia and Vietnam account for the highest fish consumption in the world (Baran 2005).[4] The annual consumption of fish and other aquatic resources is up to 60 kg per capita per year (Sverdrup-Jensen 2002) and as high as 75.6 kg per capita per annum when taking various forms of preserved fish into account (Ahmed et al. 1998).[5] Fish and fish products comprise 40 to 60 percent of the animal protein intake of rural Cambodians and Vietnamese (Baran 2005).[6] When dividing the overall catch by the population, Cambodia is the most intense inland fishery in the world (FAO 2003). Disaggregated statistics about Vietnam are not available, however, BARAN assumes a similar fishing intensity (Baran 2005). Thus, fisheries, contributing four percent to the GDP in Vietnam and 12 percent in Cambodia (FAO 2009a; 2009b), play an essential role in the national economies and in the daily food consumption of Cambodians and Vietnamese. Besides this importance for food consumption, fisheries diversify livelihood activities and thereby "insure" against the risk of agricultural failures. They proved easy access to income generating activities with little capital investment, even under the conditions of no availability of private lands. They thus play a vital role in food security and in maintaining and improving nutrition (McKenny and Tola 2002).

In 2002, aquaculture represented only 12 percent of fish resources basin wide (Sverdrup-Jensen 2002) and mainly concerned capture fish grown in cages or ponds (Sverdrup-Jensen 2002; Dey et al. 2006). At least in Cambodia, it is thus rather wild fish, and not aquaculture, that provides food to millions in the region. BARAN states that the aim should therefore be to "[…] protect and optimise the exploitation of a huge natural capital rather than counting on the development of a meagre aquaculture sector as an alternative development option" (Baran 2005, 15). In contrast, during the past ten years a five-fold increase in aquaculture production was observed and the continued expansion might be a possible contribution to meet the need for fish products in the coming decade (Sverdrup-Jensen 2002; Dey et al. 2006). In future, the number of rural small-scale farm HHs engaging in aquaculture and local small-scale hatcheries, hapa nursing[7] and on-farm breeding is expected to increase (Sverdrup-Jensen 2002). Especially by improving food security, aquaculture is expected to contribute significantly to poverty reduction and improved livelihoods (Dey et al. 2006).

To summarise, both countries possess vast natural resources that are of utmost importance for the rural society but also for the national economies. Besides rice cultivation, fish is the main income source and contributes significantly to the diet of Cambodians and Vietnamese. However, governing these

[4] The estimated capture fisheries production is 289,000 up to 431,000 tons for Cambodia and 190,000 for Vietnam (van Zalinge et al. 2000). The total catch from inland fisheries worldwide amounts to nine million tons, and the Mekong Basin actually contributes 17 percent of this total (Baran 2005).
[5] Other animal protein intakes (e.g. chicken, pork, beef) only account for eight kg per year per person (Baran 2005).
[6] Some research also suggests this figure to be closer to 75 percent (Ahmed et al. 1998; Keskinen 2003). This value would be 40 percent of that of the rice production (Guttman 1999).
[7] Hapa nursing is the nursing of fingerlings using a mixture of rice bran and livestock feed concentrate (Edwards et al. 2002).

large natural resource stocks is challenging and sustainable management practices are essential for securing also future benefits of the resources. The next subsection gives a brief overview about the legal and regulatory framework in place that aims at securing a sustainable resource use.

1.1.2 Governance mechanisms in Cambodia

In Cambodia, tenure issues, the management of common property as well as collective action are strongly influenced by recent history. In the last four decades, Cambodia was subject to several collectivisation efforts, resettlement policies and re-privatisation initiatives. Traditionally, a family took what was needed for subsistence without hurting the collective rights (Van Acker 1999, 29), while the land belonged to the king. During the French protectorate (1863-1953) the "Cambodian Civil Code of 1920" aimed at a general registration of land and a national cadastre system was introduced (Van Acker 1999, 30). All unoccupied areas were considered as "free" and became available for sale. This legal concept based on the French legal construct of a "domaine privé d'Etat" weakened the traditional Cambodian agricultural system (Van Acker 1999, 30). However, formal registration and the former traditional system continued to coexists. With the beginning of the so-called "Buddhist Socialism" in the mid-1960s, many Khmer were resettled and land was forcibly redistributed even before the rise of the Khmer Rouge (Van Acker 1999, 30). Then, with the commencing of the Khmer Rouge regime in 1975, all private property was abolished and property records were systematically destroyed (Van Acker 1999, 4; Törhönen and Palmer 2004). The population was marched out of cities and was reduced to slave labour in collective work camps. With the Vietnamese invasion in early 1979, "[…] the entire population - in search of lost family and a home - spilled over the countryside once again" (Van Acker 1999, 28) and the Vietnamese system of collectivisation was introduced. However, it was less forbidding and different levels of private property, e.g. on means of production, were to be found (Van Acker 1999, 4; Törhönen and Palmer 2004). In 1989, the government then abolished all past collectivisation efforts and reintroduced private ownership (Van Acker 1999, 31). Today, the decentralisation endeavours of the Cambodian government aim at giving more power to lower level institutions. Newly established laws on land, water and fisheries are already in place aiming at increasing the long-term sustainable resource management (Van Acker 2003b).

The following national legislation provides the basis for the presented research in the Cambodian communities:

- The Land Law of 2001 (RGC 2001b);
- The Law on Water Resources Management of 2007 (RGC 2007); and
- The Draft Cambodian Fisheries Law of 2001 (RGC 2001a).

The Land Law adopted in 2001 provides the legal basis for land ownership in Cambodia today. Following the technical language of the law, owners of immovable property, such as land, are granted

all rights to their property, including exclusive use rights (RGC 2001b, Article 85), rights of changing the property (RGC 2001b, Article 87-89), the rights to enjoy the fruits of the property (RGC 2001b, Article 94) as well as to sell the property (RGC 2001b, Article 6). Thus, according to the Land Law, owners hold the full bundle of property rights (see section 2.3.1). Article 91 also states that "[t]he owner of the land's surface is also the owner of the space situated directly above his property […]" (RGC 2001b). In 2002, the Ministry of Land Management, Urban Planning and Construction (MLMUPC) established the Land Management and Administration Project (LMAP) with the focus on implementing the Land Law (RGC 2001b) and to systematically register all land in Cambodian within a cadastral survey and to give title to the owners. The MLMUPC set up central as well as provincial/municipal cadastral offices and is today responsible, in cooperation with local authorities, the military and the police, to carry out the necessary work to develop the cadastral maps (RGC 2001b, Article 235). Nearly one million parcels in 11 provinces have been registered until now (Bekhechi and Lund 2009). However, in many parts of Cambodia, land is not registered in the cadastral system yet and many people still do not hold a legal private property title to their cultivation and/or homestead land.[8]

The ownership and management of water resources in Cambodia is determined by the Law on Water Resources Management of the Kingdom of Cambodia (2007), which states that "[a]ll water and water resources are owned by the State" (RGC 2007, Article 3). However, "[e]very person has the right to use water resources for his/her vital human need [...]", which include domestic purposes, fishing and irrigation of domestic gardens. Thus, although the area above the land is the property of the person owning the land, water flowing over the land is open for public uses. These uses do not require licensing (RGC 2007, Article 11).[9] In order to ensure sustainable water management of irrigation systems, the Ministry of Water Resources and Meteorology (MOWRAM) is obliged to establish Farmer Water User Communities (FWUC) with farmers using water from the same irrigation systems being members in the same FWUC (RGC 2007, Article 19). A community committee is elected by the communities to govern the FWUC, which enforces the community by-law as defined by the MOWRAM; ensures the operation and maintenance of irrigation scheme and collect fees as defined by the community (FWUC 2004). The Ministry also establishes Farmer Water User Groups and Sub-Groups (FWUG) that implement the community's work program, coordinate between the group members and the community and collect fees from group members. Members of a FWUG shall apply for membership of a group based on the community by-law, whereby membership is only possible when land is owned within the respective reservoir (FWUC 2004).

[8] People will need to legally possess the land they want to register for five years before they can register as the owner of the parcel (RGC 2001b, Article 30 & 31).
[9] The diversion, abstraction and use of water resources for purposes other than those mentioned in Article 11, as well as relating constructions, are subject to a permit (RGC 2001b, Article 12).

Cambodian fishing rights are defined in the Draft Cambodian Fisheries Law of 2001. It is stated, that all "Fishery Domains shall be owned by the State" (RGC 2001a, Article 4).[10] Fishery domains are divided into different types, including fishing lot areas, sanctuaries, inundated forests as well as family-fishing areas (RGC 2001a, Article 5). Fishing is prohibited during the closed season (RGC 2001a, Article 12), except for family fishing that is allowed at any time in the respective areas (RGC 2001a, Article 15).[11] However, the use of certain fishing gears is prohibited, including e.g. electrifying devices, explosives as well as fine mesh nets (e.g. mosquito nets) (RGC 2001a, Article 24).[12] Non-compliance with Article 24 can lead to fines of 20,000 to 5,000,000 Riel (RGC 2001a, Article 112, 114).[13] Further, the gears that have been illegally used can be confiscated by the Fishery Administration (FiA) (RGC 2001a, Article 86). "All Cambodian citizens have the right to form a Fishery Community in their own areas on a voluntary basis to take part in the management, conservation, development and use of fishery resources with sustainability" (RGC 2001a, Article 76), whereby regulations and plans shall be approved by the FiA. Prosecutors, the police or other competent authorities do not have the right to "[…] investigate and/or file the case for a court as a general crime […]" and the "[i]nvestigation, prevention, crackdown of the fishery offences are the responsibilities of the Fishery Administration at all levels in respective jurisdictions" (RGC 2001a, Article 82). However, local authorities and armed forces shall provide the FiA with the forces to investigate and crack down on fishery offences, when requested by the FiA (RGC 2001a, Article 84).

To summarise, different ministries and their administrative entities at different jurisdictional levels are concerned with the management of natural resources. Land, water and fisheries are all interconnected and it becomes obvious that, depending on seasonal changes, the one or the other law might apply to a specific area. The different laws must therefore be considered within the dynamically changing natural environment. The same is true for Vietnam and the following section introduces the Vietnamese laws on land, water and fisheries.

1.1.3 Governance mechanisms in Vietnam

Although the Vietnamese economy is more diversified, the majority of rural HHs also still relies on natural resources to make a living. As in Cambodia, the resource use of natural resources is influenced by the historical developments which led to several tenure system changes in the last decades. Since the Geneva Accord of 1954, Vietnam was a French protectorate and most farmlands were either owned by French or by Vietnamese landlords and were characterised with a high unequal distribution.

[10] Fishery Domains are divided into Inland and Marine Fisheries Domain. Inland Fishery Domains include rivers, tributaries, lakes, streams, effluents, creeks, reservoirs, inundated forest areas, canals, ponds, or deep water holes getting water from rivers, tributaries, lakes or effluents (RGC 2001a, Article 4).
[11] Depending on location, closed season is from June to Sept./Oct. for inland fisheries (RGC 2001a, Article 12).
[12] Electric fishing describes a fishing method, where electricity is used to draw fish to the surface where it can be then easily fished. Done in a scientific manner, the threats to the fish stock are minimised. However, local farmers often use batteries to stun fish, which can be harmful as also small fish/fingerlings get caught that usually would sustain in the waters.
[13] 1 US$ = 4,000 Riel. Thus, the fines are equivalent to an amount between five and 1,250 US$.

In 1954, Vietnam became independent from the French colonial rule and was divided into two parts (North and South Vietnam). In the North, land was redistributed to farmers which caused a significant increase of agricultural production. In the 1950s, Communist ideology gained strength and land was collectivised (Do and Iyer 2004, 4). In the South, during the same period, political conflicts influenced land institutions. Although, land collectivisation started also in the South, farmers in the Mekong Delta resisted this collectivisation and continued to farm individually instead of collectively (Do and Iyer 2004, 4; Kirk and Tuan 2009, 140). In 1986, the "doi moi" program was announced by the government and the movement towards a market economy started. Production subsidies were eliminated and the economy opened up to domestic and international trade (Do and Iyer 2004, 3). In the agricultural sector, the Resolution 10 of 1988 was an important step towards a market-based economy after abandoning collective farm systems (Ravallion and van de Walle 2003). Nevertheless, especially local governments still dominated the cropping patterns for specific types of land, thereby discouraging further diversification and commercialisation (Kirk and Tuan 2009, 142). The new land law in 1993 attempted to foster free transactions in land-use rights and gave the power to the HHs in form of exchange, transfer, lease, inherit and mortgage of their land-use rights (Do and Iyer 2004, 7). However, land remained state property and further reforms of land tenure regulations must follow to further strengthening farmers' rights (Ravallion and van de Walle 2003; Kirk and Tuan 2009, 144).

Today, the following legislations determine the land, water, fishing and aquaculture production rights in Vietnam:

- The Law on Land 2004 (SRV 2004);
- The Law on Water Resource (SRV 1998); and
- The Fisheries Law (SRV 2003).

In Vietnam, "[l]and belongs to the entire people with the State as the representative owner" (SRV 2004, Article 5 (1)) with the state having the right of land disposal, including the determination of land prices and the granting land use rights (SRV 2004, Article 5). The state issues certificates of use rights to land users (SRV 2004, Article 10 (1)) and allocates (or leases) land to families and individuals "[…] directly working in agriculture, forestry, aquaculture […]" (SRV 2004, Article 33 (1)). According to the Law on Land (SRV 2004), rights on land are use rights with the "[r]ight to exchange, assign, lease, sub-lease, bequeath and donate land use rights; right to mortgage, guarantee and contribute capital using land rights […]" (SRV 2004, Article 106). These use rights are granted to families and individuals for 20 years in e.g. the case of annual crop land and 50 years for forests and perennial crop land (SRV 2004, Article 67 (1)).[14] This land allocation is based on quotas and the law states that "[t]he quota on allocation to each family household or individual of land for planting annual crops, land for

[14] When the duration expires, the State shall continue to lease the land if the land user wishes to continue using the land and if the land use still conforms with the approved land use zoning (SRV 2004, Article 67 (1)).

aquaculture […] shall be no more than three hectares of each type of land" (SRV 2004, Article 70 (1)). Further, land users have the right to receive a certificate of land use rights, to enjoy the benefits of their labour and investments in the land and to be protected by the state in case someone infringes their use rights (SRV 2004, Article 105). These use rights also oblige the right holder to use the land for "the correct objectives", to "protect the land" and to "[…] hand over the land when the state issues a decision on land recovery or upon expiry of the land use term" (SRV 2004, Article 107).

Like in Cambodia, "[t]he water resource comes under the ownership of the entire people under the unified management of the State" (SRV 1998, Article 1).[15] Organisations and individuals have the right to "[…] exploit and use the water resource for life and production" (SRV 1998, Article 1). These rights include the exploitation of water resources for agriculture and aquaculture (SRV 1998, Article 22).[16] "The People's Committees of the communes […] have the responsibility to coordinate with the agencies, organisations and individuals in the reconciliation of the disputes on water resources […]" (SRV 1998, Article 62).

Vietnamese fisheries resources are owned by the people under the management of the State and individuals as well as organisations have the "[…] rights to exploit the fisheries resources […]" (SRV 2003, Article 3). Fishing in closed areas, during closed season, overfishing as well as the use of illegal fishing gears is prohibited (SRV 2003, Article 6). Additionally, it is also prohibited to conduct "[…] new aquaculture activities without permission of Ministry of Fisheries […]" and to conduct "aquaculture that is inconsistent with [the] masterplan and […] cause[s] adverse impact on the activities of other sectors and occupations" (SRV 2003, Article 6). The provincial People's Committee (PC) is responsible for issuing rules of fishing grounds in accordance with the Ministry of Fisheries (MoF). Fishing rules are implemented by the Aquatic Resource Management Department, which is part of the Department of Agricultural and Rural Development (DARD). The MoF, in coordination with relevant Ministries and provincial PCs, also formulates a masterplan on aquaculture development nationwide (SRV 2003, Article 23). All aquaculture initiatives must be implemented in accordance with this masterplan as well as the MoF "[…] shall issue standards, process and procedures of aquaculture sites; shall chair the coordination with relevant Ministries and ministerial-level agencies, provincial People's Committees to provide guidance, examination and recognition of qualified aquaculture sites […]"(SRV 2003, Article 24). Establishing aquaculture also comes with a series of rights, including the protection by the State when others violate legal rights to use aquaculture land and the possibility to receive training on and transfer of new techniques on aquaculture (SRV 2003, Article 25). However, organisations and individuals engaged in aquaculture also have several

[15] Further, all canals, roads and rivers are considered as public goods (PGs) and remain under the responsibility of the governments, whereby farmers are requested to contribute labour and money for construction works and maintenance activities (SRV 1998). This is also true for Cambodia (RGC 2001b, Article 58).
[16] Permissions for water use are not required when surface water and underground water are used for small-scale family purposes (SRV 1998, Article 24).

obligations, including reporting duties on aquaculture statistics (SRV 2003, Article 26). It is also stated in the Law on Land (2004) that changing water uses requires permission by the "competent State agency" as well as damages caused by the new water use require compensation (SRV 1998, Article 35). It further specifies, that "[l]and users of specialized land for wet rice cultivation shall be responsible to improve and fertilise the land and not to convert it to use for […] aquaculture […] unless the competent State body provides permission" (SRV 2004, Article 74). Also the Vietnamese Fisheries Law (2003) explicitly states that aquaculture activities "[…] must be done in compliance with the land law and other relevant legislation" (SRV 2003, Article 27).

To conclude, in both countries, land and water rights were completely rearranged for several times during the last decades. Today, land in both countries is individually cultivated and is either *de facto or de jure* private. In Cambodia, the registration of private property is underway, while in Vietnam, the Law on Land of 2004 provides the legal basis for private use rights on land. However, water is a public good (PG) in both countries. Water from lakes, reservoirs and streams serves as irrigation source and is openly accessible for fishing and other purposes. This leads to the fact that use rights on land and water change with the season. As soon as water covers the land in the wet season, the boundaries between the plots become invisible. Consequently, (de jure or de facto) private land property turns into public water property and is legally accessed by many individuals and communities for different purposes.

1.1.4 Challenges for natural resource management in the Mekong Delta

Although legislation is established and implemented, which aim at improving natural resource management in the region, there is an increasing pressure on the natural resources observed today (Torell et al. 2003, 8; Sour and Hav 2004, 1; Cai et al. 2005, 15). Due to an increasing population more people are using the same amount of resources, which puts them under pressure. Further, large-scale water control projects, have been initiated to support the intensification of rice production (Torell and Salamanca 2003, 9) as well as energy production. These man-made built structures modify flow patterns of the Mekong and its adjacent streams and contribute to the loss of spawning and refugee areas for fish. However, besides demographic reasons and technological changes, the main reasons for these threats are seen in inadequate institutional arrangements with missing, poorly defined or overlapping jurisdictions, a lack of involvement of local resource users and ineffective enforcement measures (see for example Nang 2003, 21-23; Torell et al. 2003, 11; Sophal 2004, 22; Sour and Hav 2004, 9; Bonheur et al. 2005, 11). The institutional arrangements governing the resources involve a large number of agencies under various ministries with limited coordination and cooperation between the involved parties (Bonheur et al. 2005, 11). Clear regulations in regard to the rights local users have on the resources are not in place (Bonheur et al. 2005, 11-12; Cai et al. 2005, 15-16). Civil society organisations are not yet established or involved and participatory decision-making processes (Nang 2003, 23; Torell and Salamanca 2003, 15) as well as appropriate institutional arrangements to ensure

access and appropriation rates are missing (Cai 2003, 63). This is alarming as especially the poor depend on access to these resources. Research also revealed that some common property (e.g. land, forests as well as water) has been transformed to private property (Giang et al. 2003, 72) and a declining access to common-pool resources (CPRs) by rural HHs can be observed (Van Acker 1999). Further, measures for control and monitoring are not fully implemented yet (Binh 2003, 49) and government laws lack clear regulations on the use of pesticides, fertiliser and the introduction of new aquaculture technologies (Vanhan 2004, 20).[17] The current situation with poorly defined property rights and governance mechanisms leads to open access situations in most of the wetland resources. The replacement of traditional tenure regulations and laws with new laws disregarding common property rights has increased conflicts among wetland stakeholders, with the loss of traditional tenure mainly affecting the poor (Van Acker 2003a; Cai et al. 2005, 16).

KIRK (2004) also points out that in Cambodia the official data available about land and water resource rights is insufficient and often property rights are not yet identified and catalogued. The country wide land titling and land valuation system is not yet established and especially rural areas lack data about common property issues. Broad based local analyses are therefore necessary to understand by whom and how the resources in rural areas are actually used and more applied research is advisable to better understand the complex livelihood strategies of the poor and the key role of land (Kirk 2004).

Besides formal legislations, the capacities on local levels to govern resources effectively are important in sustainable natural resource management. In Cambodia, one main factor influencing the common local natural resource management is the fragile social base. COLLETTA AND CULLEN (2000) state that thirty years of warfare destroyed most of the social base in Cambodia and that the experiences of violent conflicts extend to today's social capital (Colletta and Cullen 2000, 24). During the Pol Pot regime, many families lost their homes and possessions and were often separated, forced to work in different work camps. The genocide caused the death of two millions Cambodians. Segregating policies, that encouraged spying on and reporting of each other, further destroyed bonds between families, neighbours and villagers (Colletta and Cullen 2000, 25). Trust within the population diminished. Also, WEINGART AND KIRK (2008) found low trust levels in Cambodia and state that collective action was severely undermined by the Khmer Rouge and that large parts of the social base with its traditional social networks were destroyed. Further, the resettlements and forced collectivisations also had their share on reducing people's willingness to engage in collective activities (Weingart and Kirk 2008). VAN ACKER further states that some communities might not have learnt how to deal with CPRs in a socially efficient way (Van Acker 1999, 46).[18]

[17] Aquaculture is also assumed to put to put a threat on the resources (Sour and Hav 2004, 11-12).
[18] Nevertheless, COLETTA AND CULLEN (2000) argue that also family networks redeveloped and new initiatives emerged beyond the family bonds. "[C]onflicts did not necessarily diminish the willingness of people to work together" (Colletta and Cullen 2000, 29).

The same is true for Vietnam. Collective action in the sense of civil society activities is a new concept in Vietnam due to the one-party rule and is not widely recognised by the authorities yet. Nevertheless, although the conditions for forming organisations are restricted by the Party, social organisations have gained influence in the last decades (Norlund 2007, 69-74). Many formal and informal civil society groups developed and aim at improving the livelihoods of the poor (Norlund 2007, 76). Further, faith-based organisations can be found including Buddhist and Catholic groups (Dalton et al. 2001; Norlund 2007). However, group membership does not necessarily fit the civil society model found elsewhere in the world (Dalton et al. 2001, 11). Also, state funded organisations are in some cases less participatory in the sense that people may be formally members without being actively involved (Dalton et al. 2001, 4; Norlund 2007, 78).[19] The World Value Survey, conducted in 2001, came to the conclusion that organisational membership is widespread, but that the depth of civil society is rather low because membership in organisations is not considered voluntary in many cases and members are often not very active (Norlund 2007, 79). However, many community-based organisations and cooperatives are existent today and take the lead in managing natural resources, combating environmental pollution (Thayer 2008, 7). The survey also found a high level of trust within the Vietnamese society (Dalton et al. 2001, 6; Norlund 2007, 81).

Summarising, the recent Cambodian and Vietnamese history significantly influences the management of natural resources and collective action on the local level. People are still uncertain whether their claims on property are secure, because the conflict settlement is still an on-going process and different sources of land law are in force. Additionally, the social base in Cambodia is still fragile and makes collective action a serious challenge. A participatory institutional structure is still underdeveloped due to the brutal era of military regime and persisting corruption and power structures characterise the people's life instead of the legal system and the rule of law. Also in Vietnam, the social base might still be weak and real participation and collective action might be difficult to realise.

This analysis of existing institutional arrangements on local levels in the respective communities is the starting point for this research. Understanding the access and use rights is a perquisite for the collective management of natural resources as well as for the implementation of a community-based aquaculture project. In the next section the basic ideas of the CBFC project, used as a reference frame in this research, as well as its objectives will be introduced.

1.2 The reference frame: a community-based aquaculture project

In 2005, WorldFish initiated a five year research project (2005-2010) in three water basins, namely the Indus-Ganges (Bangladesh), the Niger River basin (Mali) as well as the Mekong Delta (Cambodia and Vietnam) called "CGIAR Challenge Program on Water and Food: Community-based Fish Culture in

[19] Also, as stated earlier, decisions about land distribution are still often taken by local elites without the participation of local famers (see for example Kirk and Tuan 2009).

Irrigation Systems and Seasonal Floodplains (CP35)".[20] The underlying assumption is that seasonal waterbodies can be communally managed by all stakeholders under equitable and sustainable sharing arrangements. The project's main activity is to integrate the culture of fish and other living aquatic resources into existing water use systems. Thereby the project aims at enhancing the productivity of seasonally occurring floodwaters. Within this context, research on technical as well as on institutional options for community-based aquaculture is undertaken by the project (WorldFish 2005).

In the Mekong river basin there are around 0.8 million hectares of medium and deep-flooded areas that could be utilised for joint fish culture activities during the flood seasons (WorldFish 2005). Seasonal multi-month floodwaters are mostly unutilised for agricultural production, with the exception of deep water rice cultivation, which is diminishing in attractiveness to farmers due to comparatively low productivity, in particular in Cambodia. This raises the opportunity to enclose parts of these floodwater areas to produce a fish crop of specifically stocked aquatic organism aside from the naturally occurring wild species. This could lead to a higher quality, nutrient-dense food production and an enhanced farm income for rural HHs (WorldFish 2005). However, although promising significant benefits, the adoption of this technology by farmers has been low until now, mainly due to the high costs of fencing individual plots (WorldFish 2005). As a possibility to increase the benefits, fish can be cultured communally during the flood season, but fields will be cultivated individually for rice production during the dry season.

This community-based fish culture project (the project hereafter) is a joint effort of WorldFish, the International Food Policy Research Institute (IFPRI) and different National Aquatic Research and Extension Systems (NARES). The main objectives of the project were to enhance the water productivity in the project sites, to increase income of rural HHs and to improve the livelihood of the poor. Specifically, the research aims of the project were.

1. To develop a methodology for measuring water productivity at the landscape level and to assess the contribution of aquatic resources to water productivity in irrigation systems and floodplains.
2. To develop appropriate technical and institutional options for increasing water productivity at basin level through integration of community-based fish production into existing floodplain and irrigation systems.
3. To develop a participatory diagnostic and stakeholder-involving diffusion approach for community-based fish culture in shared water bodies.

[20] CGIAR stands for Consultative Group on International Agricultural Research. It is a strategic alliance of members, partners and international agricultural centres that mobilises science to benefit the poor. It established the Challenge Program on Water and Food (CPWF) in order to create research-based knowledge and methods for growing more food with less water, and to develop a transparent framework for setting targets and monitoring progress (CPWF 2005).

4. To enhance human resource capacity of NARES for supporting community-based fish culture in shared water bodies (WorldFish 2005).

The idea of the CBFC project is to encourage communities to work together to culture fish and other aquatic resources in common seasonal floodwaters. Often, HHs in the research region culture fish individually in small private ponds on their homestead. However, here the intent was to increase the productivity of seasonal occurring floodwaters through the stocking of fingerlings in larger seasonal waterbodies that are accessible by different users. Suitable built structures (e.g. dikes or nets) needed to be in place or created and thus at each project site different techniques for fish culture were used. However, in all sites, participants were expected to contribute labour and time for collective activities, including fencing/dike construction, site maintenance, stocking and harvesting, guarding of the culture sites as well as participation in group meetings. Also financial contributions had to be provided by participating farmers to contribute to the purchase of fingerlings and construction materials (e.g. nets or bamboo sticks). Additional financial support as well as advice in regard to many aspects of the project (e.g. water quality, species or technical support) was provided by the local research institutes and government agencies involved in the project. At the end of the season, the aquaculture produce was to be harvested by the group members and shared or sold to local markets with the profit divided among the group members. Within this project framework, the presented research was conducted focusing on institutional arrangements in the Mekong Delta. The next section describes the research issues, propositions and questions relevant for this dissertation.

1.3 Research issues, propositions, research questions and methodology

The research presented in this disseration was implemented from August 2006 until December 2007 along with the described project. However, while the project was implemented in three water basins, this research only covers the Mekong Delta (Cambodia and Vietnam). Further, the research presented in this dissertation aimed at complementing the project's objective No. 2 and focuses on research issues relevant for the development of appropriate institutional options for increasing water productivity. Along with the empirical research presented here, aquaculutre specialists and fisheries researcher employed by the project conducted research on technical options for community-based aquaculture and thus addressed the other three project objectives more specifically.

The **research problem** of this dissertation is to understand different institutional factors that influence the success or failure of collective action for sustainable resource management in the Mekong area of Cambodia and Vietnam. A detailed analysis of institutions combined with technical research in the project contributes to a more holistic understanding of factors influencing the likelihood of success and failure of collective action and facilitates better preconditions for the implementation of community-based approaches in the region.

It is assumed that the success of this community-based approach is dependent on the underlying institutional arrangements. The specific propositions presented here are:

a) The Greater Mekong region is characterised by unspecified, overlapping institutional arrangements which differ between Cambodia and Vietnam and change in accordance to seasonal changes.
b) Collective action arrangements play a significant role for the management of water resources in the region, but differ regionally and seasonally and must be considered during project implementation in order involve all relevant stakeholder and to enhance productivity in an efficient and equitable way.
c) Secure property rights enhance people's interest in participating in collective action and are therefore essential for reaching sustainable natural resource management in Cambodia and Vietnam (and the project's objectives).
d) In both countries, cooperation levels as well as trust levels within the villages will rather be low due to recent history. This will influence the success of collective action.

The **main objective** of this research is thus to understand the underlying formal and informal institutional arrangements that facilitate equitable and efficient community-based natural resource management in seasonal floodplains and secure the sustainability of the collective semi-intensive aquaculture production. Specific objectives are:

1. Assessing and comparing existing **institutional arrangements** for water and living aquatic resources **and their dynamics** in the changing natural and socio-economic environments of the Mekong Delta, considering legal pluralism.
2. Analysing **the impact** of different institutional arrangements for communal water management in the Mekong area of Cambodia and Vietnam.
3. **Investigating the interaction** of all relevant stakeholders and the impact on the adoptability of a collectively managed, semi-intensive rice-fish aquaculture production technology.

The **specific research questions** addressed are the following:

I. What different kinds of property rights systems relating to aquatic resources are in place in the rural Mekong area and operate in the different seasons? What kinds of coordination mechanisms and institutional arrangements exist? Which are the pros and cons associated with the effects of these different institutional arrangements at the project sites and how do they influence different stakeholder groups (who benefits - who loses)?
II. What are the incentives to participate in collective action for water management during the flood season? How does collective action influence the livelihood of people in the region? Which are the problems people face concerning collective action of water resources and the introduction of innovative techniques?

III. What cooperation and trust levels in regard to public good provision and common-pool resource appropriation are found in the communities? What institutional arrangements are required to successfully implement a community-based approach in the region so that is provides sustained benefits for the poor?

In order to answer the questions introduced, this research adopts **methodological pluralism**. A mixed method approach has been applied. The qualitative and quantitative methods used in the field have different strengths in respect to the research issue and are implemented at different stages of the research. The multi-method approach is appropriate given the complexity of the research issue. It offers a holistic view about the underlying institutional factors influencing the actions within and outcomes of the project. The methods have been chosen and designed in close cooperation with project partners in Cambodia as well as in Vietnam. Most methods were participatory due to the nature of the project. Action research was implemented in four communities that were chosen as case study sites. Additionally, a survey was used in order to get an understanding about the socio-economic situation of HHs in the region and to evaluate who participates and benefits from the project. Based on the findings from action research and the survey, hypotheses have been derived, field experiments designed and introduced to test resource user's behaviour towards cooperation. Figure 2 gives an overview about the methods used to answer each of the research issues and thus to achieve the stated objectives. A detailed description and justification about the methodology and methods used is given in section three. Section six gives further details about the specific experimental designs.

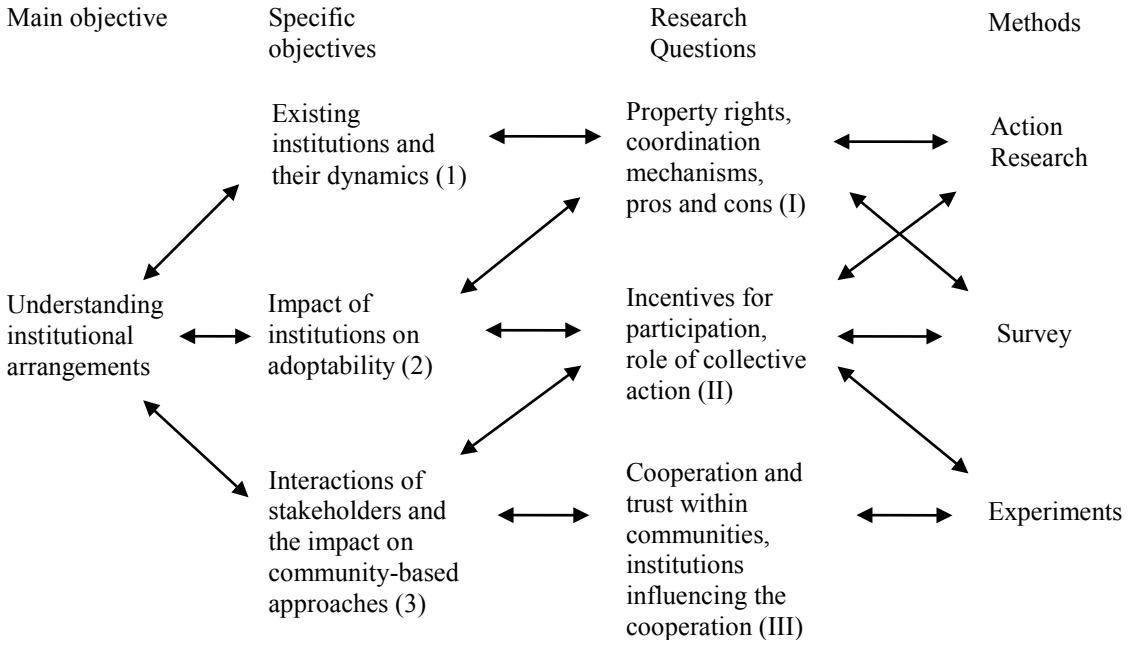

Figure 2: The research design

1.4 Justification and limitations

WorldFish recently successfully established a community-based approach to aquaculture in Bangladesh and North Vietnam (WorldFish 2005; Ahmed and Dickson 2007). These studies demonstrated the feasibility of community-based fish culture and an increase in fish production of the participating (and adapting) HHs was reached. However, there are several constraints to the development of aquaculture with many of them being institutional rather than technical ones (Sverdrup-Jensen 2002). The findings from previous research suggest that technical constraints, like e.g. water quality and the stocking composition of species, are now well understood, but there is still a need to understand and adapt institutional arrangements which foster sustained adoption and inclusion of poorer stakeholders and thus to ensure a more equitable management of low-technology aquaculture operations (WorldFish 2005). In the Bangladesh context, institutional sustainability is mentioned as one main concern during and after project implementation. Main findings in regard to institutional factors influencing the success of such an approach include e.g. the interaction between different stakeholders, support from ministries and governmental bodies at different levels, the identification of management boundaries of a project water body and the resolution of conflicts. Here, the project comes to the conclusion that it is equally important, besides understanding the biological, physical and technical aspects, to comprehend the various external social, political and institutional forces that influence the behaviour of the diverse stakeholders (Ahmed and Dickson 2007).

The importance of institutional arrangements in community-based approaches in general has been studied before and is today recognised. According to earlier research, collective action can contribute to sustainable resource management under certain conditions (see for example Ostrom 1990; Sandler 1992; Libecap 1995; Baland and Platteau 1996; Agrawal and Ostrom 1999; Meinzen-Dick and Knox 1999; Di Gregorio et al. 2004; Meinzen-Dick and Di Gregorio 2004; Weingart and Kirk 2008). The research presented in this dissertation enriches earlier field work by other scholars. Valuable insights in key factors relevant for the success and failure of community-based approaches in general will be provided. The research contributes to findings from New Institutional Economics (NIE) and experimental economics while testing several hypotheses in regard to local natural resource management. This will contribute to research conducted in other regions and in other natural resources systems as well as to the discourse about local users in natural resource settings.

The applicability of the research findings in other communities, legal systems and natural resource settings is, however, limited to the extent that institutional arrangements greatly differ in other socio-economic and socio-ecological settings. The effectiveness and long-term sustainability of local approaches is always related to locally specific institutional and organisational factors. Thus, when implementing a community-based approach in other social settings it is important to understand the specific underlying institutions and socio-ecological conditions under which different feasible technologies can be implemented.

1.5 Summary and outline of the dissertation

The first section introduced the project within the research was undertaken as well as a description of the legal framework of natural resource management in the region. Fisheries play an important role in the daily life of Cambodians and Vietnamese living the Mekong Delta. Water is an essential input for agriculture. Water covers large part of agricultural land during the flood season, bringing also fish swamps to the cultivated parcels. The presentation of land, water and fisheries regulations in the section above showed that the resources are deeply interwoven and that rights are partly overlapping with also overlapping responsibilities by different jurisdiction.

WorldFish implemented a community-based aquaculture project in different Cambodian and Vietnamese villages with the aim to improve food security and to contribute to poverty reduction in the respective communities. The collective approach enables farmers to reduce costs for fencing and fingerlings and promises higher returns in comparison to individual pond culture. However, collective approaches require a detailed understanding of formal and informal institutions. The complex interrelations between land and water tenure, resource management and the human networks need to be understood to give recommendations in regard to these kinds of collective approaches. The research questions and specific research objectives were introduced and the research design was presented. With the selected methods and the extensive field phase, the research does justice to the diverse institutional arrangements within the region, the project and the respective communities.

The dissertation is structured as follows. The following second section provides a review about theories, theoretical frameworks and related research issues in the field of collective action and property rights. In a first part, parent theories applying to this research are presented. In the second part, an in-depth analysis of those theoretical issues and findings from other scholars on the research topic will be given. In the third section, the justification for the research paradigm and for the methodology will be given. Additionally, here the methods of action research and the socio-economic survey will be described and research procedures will be explained. Section four provides descriptive data from the action research including an overview about the overall project implementation. Section five presents the results of the data gained with the survey and explores further the factors that influence project participation. In the sixth session, based on the findings presented in section four and five, hypotheses in regard to cooperation will be derived and the experimental research design introduced. Further, the results of three games implemented in eight villages in Cambodia and Vietnam will be presented. Section seven summarises, draws conclusions and gives recommendations for theory, policy and practice.

2 Theoretical background to the research

2.1 Introduction

In order to formulate hypotheses about the research outcomes and to answer the research questions posed by this research, different theories are consulted. First of all, *New Institutional Economics* is used as it offers theoretical assumptions, tools and a systematic framework for analysing institutions and the relationship between individuals and the collective in rational decision-making. Additionally, *Game theory* and *experimental economics* suggest further important assumptions and findings in regard to the research problem. Of special importance are further the theories of property rights and collective action. Also, the concepts of free-riding as well as people's behaviour towards CPRs and PGs contribute to answer the research questions.

The following section (2.2) gives an overview about New Institutional Economics (2.2.1) and Game theory (2.2.2) used as parent theories in this research. Section 2.3 focuses on the specific theory relevant for the research problem and starts with an introduction into the Institutional Analysis and Development Framework (section 2.3.1). In section 2.3.2, exogenous variables that influence natural resource management are presented. This includes an introduction into property rights and collective action as concepts. The section 2.3.3 summarises theoretical assumptions and scientific findings about three specific games that deal with institutional arrangements relevant to this research, namely public good, common-pool resource and trust games. In the last section (2.4), the theories and their application to the specific research problem will be summarised.

2.2 Parent theories: New Institutional Economics and Game theory

2.2.1 New Institutional Economics

The core ideas of *Institutional Economics* (IE) as well as *New Institutional Economics* (NIE) concern institutions and their evolution. IE had its high point of influence in the 1920s and 1930s.[21] The beginning of NIE[22] only gained attention in the 1970s, but is today associated with RONALD H. COASE'S much earlier article "The nature of the firm" (1937).[23] NIE was influenced by the "old" institutional economics and both share common interests and views.[24] Both approaches are openly interdisciplinary, recognising insights from many other sciences, e.g. psychology, history, law, anthropology and sociology (Hodgson 1998; Ménard and Shirley 2005, 2; Brousseau and Glachant 2008).

[21] THORSTEIN B. VEBLEN and JOHN R. COMMONS are regarded as the most famous institutional economists and the founders of the "old" institutionalism (Hodgson 1998, 156; 2004a, 7).
[22] WILLIAMSON (1975) coined the term "new institutional economics" (Coase 1998, 72).
[23] COASE and NORTH both are Nobel Prize Laureates (in 1991 and 1993 respectively) for their work in this genre. WILLIAMSON and OSTROM received the Nobel Prize in 2009 for the analysis of the boundaries of the firm and the analysis of especially the commons respectively.
[24] e.g. O. WILLIAMSON states that J.R. COMMONS influenced his "new" institutional economics (see for example Williamson 2000, 599).

However, IE and NIE also disagree in some of their fundamental assumptions evident in mutual criticism. For example, there is disagreement regarding assumptions about individuals. IE rejects the model of the *homo oeconomicus* with a given preference function and promotes an alternative conception of human agency (Hodgson 2004a). It is assumed that individuals are born into pre-existing institutions and build institutions through interaction. The preferences of individuals are in turn influenced by socio-economic conditions. Thus, "[…] neither individual nor institutional factors have complete explanatory primacy" (Hodgson 1998, 184) for institutional economists.[25] However, although IE contributed much in stressing the importance of institutions in economic activities, it did not manage to develop beyond its infancy and to provide a structured concept as alternative to the orthodox theoretical framework of neoclassical economics (Coase 1998, 39; Erlei et al. 2007). IE is thus often claimed not to have developed a systematic core theory and to be "anti- or not theoretical" (see for example Coase 1998, 72).

In contrast to the assumptions of IE, NIE assumes the rational, utility-maximising agent as in neoclassic economic theory and treats the individual and his preferences as given. However, NIE rejects the standard neoclassical assumptions of perfect information, unbounded rationality and costless transactions (North 1994, 2; Ménard and Shirley 2005, 2; Brousseau and Glachant 2008). Further, it does not treat the firm and the market as "black boxes" and draws attention to the institutions required to coordinate decisions and achieve effective contract enforcement (Hadfield 2005, 175; Ménard and Shirley 2005, 10; Brousseau and Glachant 2008, 9), while retaining the fundamental microeconomic assumption of scarcity (North 1995, 17-21). The aim is to understand how institutions impact on human behaviour and economic activities as well as how these activities in turn change the "rules of the game" (North 1990, 3).

NIE studies institutions and how these institutions operate. Institutions embed people in social situations (Shepsle 1989, 134) and a social framework is governing the interaction of individuals (Parsons 1940; North 1990; Erlei et al. 2007, 22).[26] The costs of exchange of goods and services in a society depend on the institutions of the society, including its legal, political, social (and other) systems. NIE wants to answer the questions why and how institutions emerge and evolve. A central issue is thus to understand human actions, assuming that they have incomplete information and limited mental capacity. They face uncertainty about the future and about transaction costs to acquire

[25] Also, the concept of habit plays a more important role in IE than in NIE. Habit is defined as "[…] a form of self-sustaining, non reflective behaviour that arises in repetitive situations" (Hodgson 1998, 178). It is regarded as crucial to the formation and sustainability of institutions. In turn, institutions are essential in providing habits for transforming information into knowledge and thus individuals rely on the acquisition of those. Thus, "[i]ndividual habits both reinforce, and are reinforced by, institutions" (Hodgson 1998, 171). See for the concept of habit and its importance HODGSON (2004b).

[26] Critics state that assuming individuals as given and the idea that institutions emerge from an institution free "state of nature" is "theoretically misconceived". The development of institutions depends upon communication and a number of institutions thus must be existent in the first place. See for example HODGSON (1998, 183). For critics in this regard related to Game theory see e.g. FIELD (1984).

information (Alchian 1950; North 1990). NIE wants to understand the incentives and intentions, including the beliefs, norms and rules that individuals create to reach their goals.[27]

Institutions are created by humans to reduce information and transaction costs. They are the *formal and informal rules, norms and constraints* as well as the enforcement characteristics of those rules (North 1994, 2). Formal and informal institutions might complement each other, but can also be in conflict. *Formal institutions* can be written rules and agreements, constitutions, laws and regulations. They can support the effectiveness of informal institutions and may also modify, revise or replace informal institutions (North 1994, 46-47). However, formal institutions constitute only a small part of the constraints people face in their daily life and are "seldom the immediate source of choice" (Coleman 1990; North 1990, 36). Rather, *informal institutions,* the (unwritten) codes of conduct, norms of behaviour, beliefs, conventions, habits of thought and codes of conduct with potential rewards for compliance and potential punishment for non-compliance (Coleman 1990, 242) "[…] affect the costs and benefits which individuals take into account when exercising choice" (Coleman 1987, 135) in their daily interactions (North 1990, 46-47). Informal institutions build an important component of a stable society and are deeply embedded in the society's history as well as in its ethnic and religious culture. They do not change immediately in reaction to formal rules (Coleman 1987; Coleman 1990, 242; North 1990, 36). CRAWFORD AND OSTROM (1995) understand the term institutions as rules, norms and strategies (Crawford and Ostrom 1995, 583). Enforced by the collective, rules define what an actor must, must not, may, can, and cannot do (Commons 1934; Ostrom 2005b). They are prescriptive linguistic entities that organise, regularise and make understandable (Ganz 1971). They coordinate activities, are mutually understood and enforced in particular situations in a predictable way (Ostrom 1980, 311; Crawford and Ostrom 1995).

Summarising, institutions create routine patterns of behaviour (Hodgson 1988) and are a product of implicit or explicit human efforts to give order to an uncertain world (Ostrom 2005b, 18). However, institutions as the "rules of the game" set limits to human behaviour. They define what is felt to be "proper, legitimate, or expected modes of action" (Parsons 1940, 190) and define the incentives as well as constraints that determine the choices that individuals make. The constraints imposed by the institutional framework (together with other constraints) define the opportunity set and therefore the kind of organisations that will come into existence (North 1990, 7; Ménard and Shirley 2005).

Some of the main concepts developed and used within NIE are *transaction cost theory*, the concept of *bounded rationality* as well as *property rights theory*. *Transaction costs theory* provides the starting point for NIE and was first mentioned by COASE (1937).[28] The theory offers an explanation to the

[27] This understanding of beliefs is also of special importance in regard to understanding economic, political or social change (North 1990, 3-6; North 1994; Williamson 2000, 597).
[28] COASE (1937) used the term "costs of using the price mechanism" (Coase 1937, 390).

existence of alternative modes of organisation as it explains when it is of advantage to organise transactions in markets, when in firms and when other - hybrid forms - are more suitable for certain transactions (Ménard 2005, 282). In neo-classical theory it is assumed that transactions can be undertaken at zero costs. However, transactions are costly and entail costs of searching information, negotiating with transaction partners, contracting, monitoring and enforcing contracts (Coase 1937, 390-391). Institutions are a means of reducing these transaction costs. [29]

The concept of *bounded rationality*, developed by SIMON (1957), states that the individual is, due to the complexity of the world, not able to optimise his decisions.[30] "[T]he intended rationality of an actor requires him to construct a simplified model of the real situation" (Simon 1957, 199). Actors face uncertainty in predicting future events, outcomes and the behaviour of transaction partners. This uncertainty is evident in all situations. Further individuals have a limited mental capacity (North 1995, 18). To still be able to act humans follow routines and rules - they establish institutions (Erlei et al. 2007, 7).

Due to the complexity of the world, the uncertainty about the future, bounded rational actors are not capable to develop complete, but only *incomplete contracts*. It is simply too costly to ensure against all eventualities through complete contracts. This however, gives room for opportunism (adverse selection, moral hazard and free-riding) or simple misinterpretation by the parties. This produces uncertainty and requires other solutions (Coleman 1990, 91).[31] Institutional arrangements can decrease the uncertainty as they give actors expectations about the future behaviour of their transaction partners (Parsons 1940, 190) and are thus relaxing the constraints of bounded rationality. They provide schemes of references for future actions, and enable controlling opportunistic behaviour (Erlei et al. 2007, 202-203).[32] When information is costly and property rights are poorly protected, contracts become hard to specify and to enforce. Then, transaction costs are high. In order to still be able to act, diverse *enforcement mechanisms* can be used such as self-enforcement, reputation, organisation or contract law. Generally, using an enforcement mechanism is also costly. The selection of a specific enforcement mechanism is thus dependent on the costs and efficacy in regard to the alternatives available (Hadfield 2005, 180). Instead of being based on formal institutions, many contracts rather rely on baseline institutions like trust and family (Hadfield 2005, 180; Ostrom 2005b, 79).

Property rights theory emerged with ALCHIAN (1965) and DEMSETZ (1967). Property rights embed transactions into specific institutional environments and reduce contractual hazards as they enable an

[29] However, changing institutions also imposes transaction costs on the participants (Shepsle 1989, 144).
[30] SIMON is Nobel Prize Laureate in 1978 for his behavioural concept of bounded rationality.
[31] Opportunism is deceitful behaviour intended to improve one's own welfare at the expenses of others. It can be unconscious shirking, but also calculated effort to defraud others (Ostrom 2005a, 51).
[32] This is also subject to the principal agent theory.

internalisation of external benefits and costs.[33] Property rights develop (to internalise externalities) when the gains from internalisation exceed the costs of internalisation. Through the assignment of property rights, transaction costs can be reduced and individuals are enabled to make expectations about the likely behaviour of others (Demsetz 1967, 347-350; Libecap 1989) and to know what is proper or improper in a given society (Alchian 1961; Coleman 1990, 242).

To summarise, formal and informal institutions support different aspects of transactions of everyday life. Transactions are costly and humans act bounded rational. Complete contracts cannot be established, thus enforcement costs emerge. Institutions reduce these costs as they give humans the opportunity to make assumptions about the future and the behaviour of the transaction partners they are dealing with. Institutions are established by humans to reduce uncertainty.
The formal and informal institutions established by and relevant to the communities' natural resource management are subject of this research. Using natural resources that are shared by many users always influences the decisions of other users. Thus, institutions are necessary to reduce costs and the uncertainty about other users' behaviour. In experimental economics, the decisions e.g. different resource users take and their influence on other users are subject to research. The decision-making and coordination among different users is depicted in games. Here, the actors or resource users are the *players of the game* - institutions provide the framework within the players act and are literally the *rules of the game*. The following section introduces the main theoretical assumptions of Game theory and experimental economics.

2.2.2 Game theory and experimental economics

Game theory is recognised as a scientific discipline since the influential publication of JOHN VON NEUMANN and OSKAR MORGENSTERN "Theory of Games and Economic Behaviour" in 1944. However, Game theory became only an important part of economic theory after the late 1970s (Roth 1995, 20-21).[34] In Game theory, situations of strategic interaction are analysed. In these situations, the individual's optimal behaviour is dependent upon on the behaviour of other actors. This is relevant when analysing behaviour in natural resource settings, where e.g. the decision to appropriate from a natural resource also influences the benefits of other community members. Game theory offers analytical tools for analysing those strategic interdependencies. Its basic assumptions are that 1) decision-makers are rational and pursue well-defined objectives and 2) that they act strategically so that they take into account their expectations of others' behaviour (Erlei et al. 2007, 12-13). *Experimental economics* tests assumptions of Game theory in laboratories and the field, analysing the behaviour of players.[35] It became mainstream in the 1990s when a series of experiments began in

[33] An externality could be, e.g. the overfishing of public fishing grounds. The costs of the overfishing are not only borne by those who cause overfishing, but by the society as a whole.
[34] Famous game theorists of the first generation are JOHN FORBES NASH, JOHN HARSANYI and REINHARD SELTEN who are Nobel Prize Laureates in 1994 for their work in Game theory.
[35] SAUERMANN (1967) seemed to have coined the term "experimental economics" (Roth 1995, 19).

which investigators responded to each other with further experiments.[36] Both Game theory and experimental economics are, similar to NIE, openly interdisciplinary and draw on findings from e.g. psychology, biology, sociology and political science (Roth 1995, 21; Gintis 2000; Siegfried 2006).

Game theory aims to give precise assumptions about the behaviour of individuals in social and economic interaction (Roth 1995, 18). Here, decision situations are called "games", although they are rather abstract analytical mathematical models for computing payoffs from choices of strategies. However, Game theory "[…] is extremely insightful in analysing real-world problems" (Gintis 2000, 15). A *player* in a game is everyone who makes a choice or who receives payoffs from the outcomes of choices. Players take choices from a set of possible actions according to the *rules*. The complete set of actions is a *strategy*. Players can have different levels of *information* about the number of players, their respective strategies and the payoffs (Holler and Illing 1993; Camerer 2003). The results of the game change with the number of players, the strategies and the information available to the players.

One can distinguish between *cooperative* and *non-cooperative Game theory*.[37] In *cooperative Game theory*, coalitions between players are analysed. Groups of players (coalitions) may enforce cooperative behaviour and agree on binding commitments that are essential for a cooperative equilibrium (Luce and Raiffa 1957, 114). The players share the payoffs of the coalition in a manner that there is no better solution for any of the players to form another coalition. Cooperation will only happen when each player will have a potential utility of the coalition and if the commitments are credible.[38] The player's payoffs thus depend on the coordination of commitments as well as on the way payoffs are shared among the players (Holler and Illing 1993, 23-24). Cooperative Game theory analyses competition between coalitions of players, rather than between individual players. The latter one is subject to the *non-cooperative Game theory*. Here, subjects play „against each other" in the sense that they only maximise their own payoffs, hence, take decisions independently. The other players are only relevant as their actions influence the own outcomes. In these games, players are not able to form binding commitments (Luce and Raiffa 1957).[39] The non-cooperative games are subject to the research presented here as people's behaviour in natural resource management is analysed. Here, people take their decisions independently and aim at maximising their payoffs. They are, per definition, not able to make binding commitments to coordinate their behaviour. Thus, in the following the non-cooperative games are further described.

[36] V. SMITH received the Nobel Prize in 2002 for establishing laboratory experiments as a tool in empirical analysis.
[37] In his publication in 1950, NASH makes this distinction into cooperative and non-cooperative Game theory in explaining that his theory is fundamentally different from the one of VON MORGENSTERN AND NEUMANN as they consider coalitions among players. He calls their theory "cooperative" and then provides the foundations for non-cooperative Game theory, where players interact independent without cooperation (Nash 1950, 1).
[38] For example in a cartel the potential utility is obvious and the payoffs (profit) of all players (firms) in the cartel can be increased through cooperation.
[39] Any cooperation that evolves in non-cooperative games must be self-enforcing.

Non-cooperative games are played in *extensive or strategic forms*. The *extensive form* game is usually depicted in a game tree that consists of a number of nodes connected by branches (Gintis 2000, 10-11). Through *backward induction* a *dominant strategy* (and a solution of the game) can be identified (Gintis 2000, 16).[40] In the *strategic (or normal) game form,* interactions of players are analysed. The payoff of each player depends on the decisions of the other players and is depicted within the boxes of a matrix. In order to derive the *best response strategy* for each player in the normal form, a row and a column are selected in a way that the payoff to their intersection is the highest possible for player 1 down the column and the highest possible for player 2 across the row (Gintis 2000, 6-7).[41]

Games can be played *simultaneously or sequentially.*[42] In s*imultaneous (static) games* both players move simultaneously, or if they do not move simultaneously, the later players are unaware of the earlier players' actions (making them *effectively* simultaneous). Here, players can only make assumptions about the other players' actions (Holler and Illing 1993, 113). In s*equential (dynamic) games* there is a timely (or logical) order of moves given and the second player has some knowledge about earlier actions.[43] In both variations, information plays an important role. In a game with *complete information*, a distinction between perfect and imperfect information must be made. With *perfect information* all players know at every decision point, in what situation they are, what alternative decisions are possible, how the game will go on and what payoffs are at each end node (Ostrom 2005b, 51). Every information set is a single node and "nature" has no moves (Gintis 2000, 33).[44] Is any of this information missing for any player at any point of the game it is a game with *incomplete information*. Under complete, but *imperfect information*, the individual is assumed to have access to knowledge of the full structure of the situation, but may not know all the moves that other participants have taken previously (Ostrom 2005b, 51).[45] The decision situations described in this research are depicted in strategic games with simultaneous decisions under complete, but imperfect information. For example, with the decision about fishing a certain amount of fish, the fisher influences the outcomes of the other fishers as the fish he appropriated cannot be fished by another fisher anymore. The payoffs of each fisher can be depicted in a matrix, whereby the own payoff is dependent of the decisions of others (assuming a finite amount of fish in a water resource). The

[40] A *dominant strategy* is a unique strategy that remains after eliminating all strictly dominated strategies (Gintis 2000, 16).
[41] Players do not just assume rationality of the other players, but choose the best response *regardless* of the other players' decision. In a PD, for example, defection is always the best move. This is a stronger requirement than the idea of a Nash Equilibrium. The Nash Equilibrium only says that you have made your best move given what the other players have done (Gintis 2000).
[42] Often strategic (normal) form games are used to represent simultaneous decision-making and extensive form games to represent sequential situations. Thus, one also finds the notion "sequential games" for extensive games.
[43] This must not be perfect information, but a player may e.g. know that the other did choose a certain action.
[44] An example for a game with perfect information is e.g. the ultimatum game. Chess is an example for a finite game with perfect information (Gintis 2000, 33).
[45] Per definition, static games are always games with incomplete information and only sequential games can be games of perfect information, since in simultaneous games players do not know the actions of the others.

decisions are taken simultaneously, thus the fisher is not aware of how much fish the other fishers will appropriate while he is fishing. Thus, the information is incomplete. However, fishers might be aware of the structure of the situation (e.g. the amount of fishers, their payoff structure).

In many (game) situations it is assumed that players will choose strategies that implement a *Nash equilibrium*. It is defined as any pair of strategies where each player maximises his payoff given the actions of the other player. The strategy of each player is a *best response* to all other players (Gintis 2000, 13). NASH states "[…] an equilibrium point is […] such that each player's mixed strategy maximises his pay-off if the strategies of the others are held fixed. Thus each players strategy is optimal against those of the others" (Nash 1950, 3).[46] There is always a pure Nash equilibrium that strictly Pareto-dominates all other Nash equilibria (Gintis 2000, 28).[47]

Another important feature of games is whether the players' identities are convertible - games can be symmetric or asymmetric. A *symmetric game* is a game where the payoffs for playing a particular strategy depend only on the other strategies employed, not on who is playing them. This means the identities of the players can be changed without changing the payoff to the strategies.[48] *Asymmetric games* are games where there are not identical strategy sets for the players. For instance, the ultimatum and dictator game have different strategy sets for each player. In this research, two symmetric games will be presented, a PG and a CPR game, where the identities of the player as well as their payoffs are similar. A third game, the trust game is used, where the players face an asymmetric situation. Here, the strategies of both players differ. One player functions as the sender or investor and decides how much money he wants to send to a second player in the receiver or trustee group. The second player then decided how much of the received money he wants to send back. Thus, the situation is asymmetric as both players have different starting points with different strategies.

Further, there are *zero-sum and non-zero-sum games.* In *zero-sum (or constant-sum*) games, choices by players can neither increase nor decrease the available resources. The total payoffs of all players (for every combination of strategies) always add to zero (or a constant sum) (Gintis 2000, 75). A player benefits only at the equal expense of others, thus one player gains exactly the amount the other players lose. In *non-zero-sum games*, a gain by one player does not necessarily correspond with a loss by another. Thus, the aggregate payoffs of players have net results greater (or less) than zero (or a constant sum). Both simultaneous and sequential games can be a *one-shot game*, where there is only one move by each player or a *repeated game*. In the real world with real players games are generally

[46] NASH (1950) showed that every finite game of perfect information has an equilibrium point in pure strategies.
[47] One allocation of payoffs Pareto-dominates another (is Pareto-superior), if all players are at least as well off in the first as in the second, and at least one is better off. An allocation is Pareto-efficient (Pareto-optimal) if it is not dominated by any other allocation (Gintis 2000, 28).
[48] Many of the commonly studied 2×2 games are symmetric. Examples are the standard presentations of the *prisoner's dilemma* and the *chicken* game.

finished in a *finite number of moves*. However, games that last for an *infinite number of moves*, with the winner (or payoffs) not known until after all those moves are completed, are also studied. Outcomes of the games can be very different when played as one-shot, finitely or infinitely. The games described in this research are all finite and non-zero-sum games. The aggregate payoffs of all players have a net result greater than zero. The PG game and the CPR game are played repeatedly. In the trust game, every player has only one move.

Experiments, as conventional lab experiments or field experiments, systematically test game-theoretic predictions with the aim to observe regularities and to improve Game theory (Camerer 2003, 21).[49] Experiments have controlled environments that allow these observations to be interpreted in relation to the theory. Such experiments feed back into theoretical literature and are an important part of the dialogue between experimenters and theorists (Roth 1995, 21-23). Many of the experiments also attempt to control subject's motivations by paying them based on their performance (Roth 1995, 5).[50] Other experiments are based on earlier ones, examining their conclusions, by varying details of the experiments and contribute to a dialogue between experimenters (Roth 1995, 21).

In 1950, DRESHER and FLOOD conducted an experiment that is probably today's most famous game - the Prisoner's Dilemma (PD).[51] The games consists of two players with payoffs *a, b, c, d* with a > *b* > *c* > *d*. The payoff matrix is indicated below (Table 1). The two players communicate only their choices of row (1 or 2) or column (1 or 2).

		Column Player	
Row Player		1) Confess	2) Not confess
	1) Confess	c, c	a, d
	2) Not confess	d, a	b, b

Table 1: A Prisoner's Dilemma payoff matrix (Source: adapted from Roth 1995, 26)

Both players in this game would be better off (stay in prison for a shorter time) if they would cooperate (not confess). Equilibrium behaviour in this game *(c, c)* is substantially less profitable than cooperative play *(b, b)*. However, the dilemma is that it is a dominant strategy for each player to

[49] HARRISON AND LIST (2004) suggest to further distinguish field experiments between artefactual field experiments which are similar to the conventional lab experiments with an abstract framing and an imposed set of rules, but played with a non-standard subject pool (not with students). Framed field experiments further add field context in the commodity, task or/and information set. In contrast, in natural field experiments subjects do not know that they are participating in an experiment (Harrison and List 2004, 1014).

[50] This is the reaction of experimental economists to the WALLIS-FRIEDMAN critique of hypothetical choices (Roth 1995, 6). WALLIS and FRIEDMAN critically review the experiment of THURSTONE (1931). They concluded that the subject cannot know how they would react if only asked about hypothetical choices and that there is fundamental difference between hypothetical and real life decisions (Wallis and Friedman 1942). V. SMITH helped to establish a tradition of paying subjects (Ostrom 2005b, 69).

[51] The results of DRESHER and FLOOD are published in FLOOD (1958). The story about two prisoners was composed by TUCKER (1950) who took the mathematical payoff matrix of DRESHER and FLOOD and made up the story that has given the game its name (Straffin 1980; cited in Roth 1995, 87).

confess since $c > d$ and $a > b$. The only equilibrium of this game is the dominant strategy equilibrium at which both prisoners confess and receive the (non-Pareto optimal) payoff of *(c)* each. They reach the worse overall outcome (many years in prison) than any other pair of strategies would have yielded. However, the PD experiments run with real decision-makers showed that they cooperated at least to some degree which is against the assumption of general theory stating that players choose Nash equilibrium strategies as described above (Roth 1995, 9).[52]

From the 1960s onwards several series of experiments have been and still are conducted. Well known are PD and PG experiments with its associated free-rider problem. Further, coordination as well as bargaining behaviour in regard to risk preferences and information have been depicted and tested.[53] Other series concern market organisations and equilibria in auction markets.[54] In individual choice experiments, individual's preferences over different choices are modelled and run in experiments (Roth 1995).[55]

Real life and human behaviour is too complex to be depicted in an experiment. However, the games depict the essence of some aspects of real life and can help us to gain a better understanding of these special aspects of human interaction (Siegfried 2006, 68). Experimental results need to be interpreted differently to the way in which findings from natural sciences are analysed and interpreted, for example. Eliminating all influences on the behaviour of players except those controlled by the experimenter is not possible in experiments with social interaction. Players always have a personal history, which they bring into the game. Preferences depend on both the agent's personal history and the nature of the strategic interaction, and are thus always partly endogenous (Gintis 2000, 251).

After having introduced the parent theories and the underlying general concepts, the following section now focuses on the aspects of the theories that are of specific interest in regard to the research questions posed. Thus, the first part of the next section introduces the framework used for the institutional analysis, while the following two present the relevant theoretical background on property rights, collective action and cooperation in regard to natural resource management.

---

[52] PD experiments became a small industry themselves, and influenced Game theory essentially (many other games e.g. public good games are in fact PDs). AXELROD (Axelrod 1980a; 1980b; 1984) organised computer tournaments asking game theorists and experimenters to hand in decision rules for playing the PD. The tit-for-tat strategy handed in by RAPOPORT was the winner (Axelrod 1980a, 7). Only the "generous tit-for-tat strategy" was able to outrage the simple tit-for-tat at a second tournament - also computed by RAPOPORT. This strategy also accounts for the fact that players might make mistakes and defect although they actually wanted to cooperate. Here, sometimes the player cooperates although the counterpart defected (Axelrod 1984).

[53] *Coordination games* focus on how players coordinate on a particular equilibrium influenced by features of the environment that are often ignored in economic models (Roth 1995, 35). In *bargaining games* two or more players gain by cooperating, but they must negotiate a procedure for sharing the gains (Gintis 2000, 345).

[54] Experiments are e.g. formulated in terms of the aggregate supply and demand curves of the market. These experiments are run using CHAMBERLIN'S technique of giving each buyer and seller a reservation price for each unit they demand or supply (Roth 1995, 24-25).

[55] In Individual choice theory the behaviour of people in real life is in focus, e.g. player's sensitivity to the description of the choices, their behaviour towards risk as well as concepts like trust and reciprocity (Roth 1995).

2.3 Analytical and theoretical frameworks for institutional analysis

Several difficulties emerge when doing an institutional analysis. Institutional arrangements are usually *invisible* (as shared concepts and implicit knowledge), *diverse* and *complex* (due to the diversity and complexity of situations in daily life). Further, rules exist on different levels, which are multiple and nested (rules within rules within rules) at one level, but also across several levels. Institutions are difficult to identify and to measure and the conditions under which decisions are taken play an important role in the analysis (Ostrom 2005b, 4-11). In 1994, OSTROM, GARDNER and WALKER presented a framework - the Institutional Analysis and Development Framework (IAD) - that helps to identify the elements to consider when analysing (any type of) institutional arrangements (Ostrom 2005a, 827).[56] The IAD was developed for a systematic analysis of the structure of the situations that individuals face.[57] Thus, it is an important analytical tool for the research undertaken here and provides the structure for approaching the research problem.

2.3.1 The Institutional Analysis and Development Framework

In the IAD, institutions are defined as "[…] the prescriptions that humans use to organise all forms of repetitive and structured interactions" (Ostrom 2005b, 3). The IAD is a multitier conceptual approach, composed of *action arenas, exogenous variables* as well as patterns of *interaction*, *outcomes* and *evaluative criteria* (Ostrom 2005b, 14-15). Figure 3 gives an overview about the IAD.

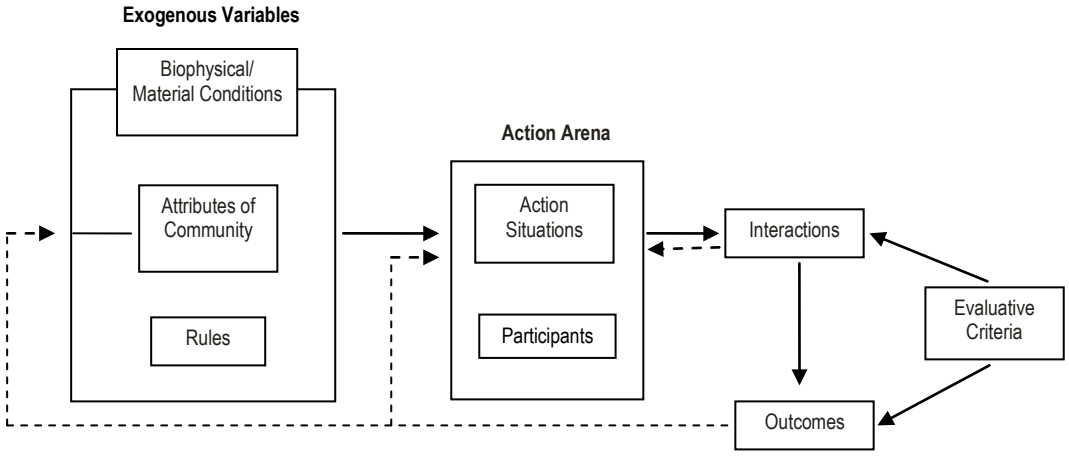

Figure 3: The IAD Framework (Source: Ostrom 2005b, 15)

As exogenous variables, the *rules*, the *biophysical/material conditions* and the *attributes of the community* influence the action arena and thus the actions individuals can take (Kiser and Ostrom 1982; Ostrom 2005b, 15).[58] The *biophysical and material conditions* of the world concern the

[56] KISER AND OSTROM (1982) initially established the IAD, which was later developed further.
[57] The framework allows comparison of diverse theories and models. The theories of PGs and CPRs as well as Game theory are all compatible with the IAD (Ostrom 2005a, 826).
[58] These exogenous variables are treated as temporarily fixed during the analysis (Ostrom 2005b, 14).

available options in an action arena and the actions that are physically possible. These conditions also determine what information is available to the participants and the outcomes that can be produced (Ostrom 2005b, 22). The values and norms of a community, the common understanding about the situation as well as homogeneity in the preferences and resources among the participants are parts of the *attributes of the community*. Often, those attributes are described with the term "culture" (Ostrom 2005b, 26-27). *Rules* (or their absence) affect individuals' choices. In their combination, they structure the decision situation (Ostrom 2005b, 3 & 17).[59]

Action arenas are composed of *action situations* and *participants*. Here, individuals interact, e.g. solve problems or exchange goods. An *action situation* is a social space characterised by 1) (individual or corporate) participants; 2) positions; 3) outcomes; 4) action-outcome linkages; 5) the control that participants exercise; 6) information; and 7) costs and benefits of outcomes (Ostrom 2005b, 14). A *participant* or *actor* is determined through assumptions about 1) the resources an actor possesses; 2) how actors valuate actions; 3) the way actors acquire and use information; and 4) the processes actors use for the selection of certain actions (Ostrom et al. 1994, 33).

Outcomes feed back to the action arena and may (slowly) transform the action arena (and thus the action situation and participants). Here, the internal valuation participants assign to outcomes need to be considered.[60] Participants in an action situation use *evaluative criteria* to assess the outcomes and interactions of an action arena (Ostrom 2005b, 12). The outcomes can, for example, be evaluated in regard to economic efficiency or equity. However, the number of evaluative criteria can be very large and can also include for example "conformance to general morality" and "accountability of authorities" (Ostrom 2005b, 66-68). When the outcomes are considered to be productive for the participants, they might increase their commitment to maintain the structure. In contrast, they might decide to change their strategies when outcomes are considered inappropriate (Ostrom 2005b, 42-43).[61]

According to the IAD, it is assumed in this research, that the exogenous variables influence the actions the people living the research communities can take. In order to examine the set of possible actions, the analysis thus starts with an analysis of the exogenous variables using action research and surveys.

[59] All rules are nested in another set of rules. The capabilities and limits of the rules at a certain level define what actions are possible at that level (Ostrom 2005b, 18-19). Three levels of rules can be distinguished. *Operational rules* impact on the day-to-day decisions. *Collective-choice rules* have an impact on operational actions. They determine who is affected by certain rules and what specific rule is to be used when changing operational rules. *Constitutional-choice rules* determine the rules to be used in developing the collective-choice rules. Thereby, they also affect operational activities and thus the outcomes of those (Ostrom 2005b, 58). The rules people use in daily interactions have been devised in constitutional and collective-choice bargaining situations (Ostrom 2005a, 835). The impact on actions chosen and outcomes of a change in one rule may depend upon the specific content of other rules-in-use (Ostrom 2005a, 837).

[60] However, often in field settings one must rather predict the outcomes as the norms might be difficult to observe although they might strongly influence the action situation (Ostrom 2005b, 64).

[61] Even when outcomes are positive, they might be perceived as unfair or inappropriate (Ostrom 2005b).

The research examines the biophysical and material conditions (e.g. the size of the water body or the technical options for fish culture), the attributes of the community (e.g. the norms inherent in the communities, the levels of trust within the community or the preferences for fishing areas) and the rules-in-use that govern the daily interactions (e.g. the access to a certain natural resource). The analysis of the exogenous variables will provide insights into the factors that influence actions arenas in the research communities. Based on this, hypotheses are developed and tested with experimental methods in order to examine how rules affect the action arena and how these need to be changed in order to increase the common outcomes. These games reduce the complexity of the real world action situations and thus enable the researcher to generate findings for specific decisions (e.g. the appropriation from a CPR) only. In the following section 2.3.2, the exogenous variables relevant to this research are described and section 2.3.3 will provide more detailed insights into the decisions in different action situations.

2.3.2 Exogenous variables relevant to this research

As outlined in the IAD, the exogenous variables influence the decisions actors can take. The rules, the physical and material conditions, the community attributes as well as the combination of rules with those and other exogenous attributes are all relevant to the analysis of action situations (Ostrom 2005b). Local natural resource users that are subject to the research presented here also find themselves in decision situations that are influenced by exogenous variables determining the choices they can take. The following section provides theoretical assumptions as well as findings from earlier research on the characteristics of natural resources, property rights and collective action as main concepts influencing the actions taken by local resource users in the research villages in Cambodia and Vietnam. Analysing the exogenous variables contributes to answering the first research question about underlying institutional arrangements and their dynamics.

Natural resource systems are characterised by a diversity of attributes that affect how rules combine with physical and material conditions. Effective rules depend on a large number of even more additional attributes (Ostrom 2005b, 26) such as the mobility of resource units, the presence of storage systems, the amount and distribution of rainfall or sluices and many other factors (see for example Ostrom 1990; Ostrom et al. 1994; Schlager 1994; Schlager et al. 1994; Agrawal 1999).[62]

A shared understanding of rules and their impacts is important when rules are established.[63] Otherwise, the stability of the rule might be low as confusion exists about what is permitted, required

[62] OSTROM synthesised major variables from many empirical studies that impact on interactions and outcomes using e.g. 30 variables identified by AGRAWAL (2001) plus others (Ostrom 2007, 15183).

[63] The rules-in-use can be further distinguished according to their direct impact on the action situation. *Boundary rules* concern entry into and exit out of the situation as well as the numbers of participants. *Position rules* define positions of participants and *scope rules* affect potential outcomes of the action situation. *Authority rules* determine actions that participants in particular positions must, may or may not take, whereby *aggregation rules* concern the level of control that an actor with a certain position exercises. *Information rules* affect the

or forbidden (Ostrom 2005b, 20). However, stability is also dependent upon *enforcement,* thus also on *monitoring* and *sanctioning* (see for example Dietz et al. 2003, 1908; Gibson et al. 2005). Rules are not self-enforcing and rely upon a human agency for enforcement (Ostrom 1980, 312). COLEMAN states that simply the acceptance of others' claims as legitimate is not sufficient for norm obedience. Only when (internal or external) sanctioning systems are sufficiently great and certain the individual will follow the rules (Coleman 1987, 141-142). If participants choose not to follow a certain rule they risk being monitored and sanctioned.[64] If the risk is low, the predictability and stability of a situation is reduced. If the risk of monitoring and sanctioning is high, the participants can expect that others will also chose actions that are permitted (Ostrom 2005b, 21).[65]

Property rights and collective action as part of the exogenous variables are of special interest to this research and specifically addressed in the research questions. It is assumed that they strongly influence the action situation and thereby also the outcomes of the action arenas. *Property rights* result from the underlying set of rules-in-use and are the social institutions that define the range of choices (Libecap 1989, 1). In institutional analysis it is useful to know to what kind of property the rules refer to (Ostrom 2005b, 22) as these institutions allocate decision-making power (Libecap 1989, 1). Property rights can be defined as "[…] the capacity to call upon the collective to stand behind one's claim to a benefit stream" (Bromley 1991, 15). They describe a relationship between the right holder and others, and a formal or informal institution to back up the claim (Coleman 1990, 58-59; Meinzen-Dick and Knox 1999, 49). Property rights theory distinguishes between the right to *use an asset* (usus), the right to *gain a return* from the asset (usus fructus), the right to *change* the form, substance and location of the property (abusus) and the *right to transfer* the property (Libecap 1989; Alston and Mueller 2005, 573). Property rights may be a number of different "bundles of rights" (Demsetz 1967, 104; Furubotn and Pejovich 1972, 1139). Different parties can claim different rights of the bundle (Alchian and Demsetz 1973). Different bundles will also give different incentives for people to act and respond to actions of others (Larson and Bromley 1990; Agrawal and Ostrom 1999, 82), with absolute power being the bundle that contains all possible rights. Different *formal* and *informal property rights* systems can exist between communities, within communities as well as between and within HHs. Formal property rights often refer to state recognised *de jure rights*, while informal property rights often refer to exercised *de facto rights* within a community or a user group (Schlager and Ostrom 1992, 254). The bundles as well as the existence of formal and informal rules result in the possibility of (de facto) overlapping property rights. To be effective, property rights need recognition and

information of participants. *Payoff rules* concern the benefits and costs that result from particular combinations of actions and establish the incentives and constraints for an action (Ostrom 2005a, 834).

[64] GANZ (1971) notes that when a person is not following a specific rule, the person might or might not know the rule. It is difficult to find out if individuals aim at following rules.

[65] Instability can grow over time as if one person can cheat without fear of being caught, others might also start breaking the rules (Ostrom 2005b, 21).

legitimacy. Governance structures must be in place or established to define, interpret and enforce the rights, thus to secure the claim on the rights (Alston and Mueller 2005).

Property rights may refer to toll (or club) goods, private goods, and public or common rights on a resource (Table 2).[66] One can distinguish these four basic goods by different levels of *exclusion* and *substractability* of use. *Exclusion* relates to the number of users and the difficulty to restrict those who benefit from the good or services. *Substractability* refers to restriction of consumption of the good or service. What one individual subtracts from the good is not anymore available for consumption by others (Aggarwal and Dupont 1999; Ostrom 2005b, 24-26).

		Substractability of use	
		Low	High
Difficulty of excluding potential beneficiaries	Low	Toll goods	Private goods
	High	Public goods	Common-pool resources

Table 2: Four basic types of goods (Source: Ostrom 2005b, 24)[67]

While *public property* is held by the state, *private property* is typically referring to an individual or legal individual (Meinzen-Dick and Knox 1999, 49). *Private goods* usually contain the full set of property rights, there is rivalry in the consumption of the good (high substractability) and the private right holder can exclude others from the use. An example is a small homestead garden. The private right holder can easily exclude others from any recreation in his private garden (e.g. fencing), while at the same time, the use of the garden (e.g. for recreation) would be strongly reduced or subtracted when many people (or even strangers) would share the same parcel for recreation.

Toll goods are characterised through a low substractability of benefits from the resources and a low difficulty to exclude other users from the resource. An example is a golf course in a golf club. Through club membership (often aligned with a fee), the club can easily exclude people from the use of the golf course. At the same time, using a golf course by one person does not immediately reduce the benefit of the golf course for another person. Thus, one speaks about a low substractability.

In contrast, *public goods* yield benefits that are non-subtractive and can be enjoyed by many people at the same time. Consumption by one does not subtract flow of services available to others (Ostrom 2005b, 23) and anyone, independent of his contribution to the provision of the good, can benefit from it (Olson 1965, 15).[68] It is difficult to exclude potential users. Examples for PGs are "peace" or a

[66] BALAND AND PLATTEAU (1996) distinguish between private property, unregulated and regulated commons and open access (Baland and Platteau 1996, 2) and stress the importance of not comparing private property with unregulated common property or open access. It is important to distinguish between common property and open access (Baland and Platteau 1996, 175-179).

[67] E. OSTROM adapted this table from OSTROM AND OSTROM (1977, 12).

[68] Note that sometimes, when a good with excludability problems is provided, all individuals must consume it, although consumption might not be wanted by all (e.g. public spraying of insects) (Ostrom 2005a, 839).

"lighthouse". If a lighthouse is installed it is impossible to exclude potential users. Every ship passing by will be able to see the lights from the lighthouse and use it as a reference point. At the same time, using the lighthouse for orientation by one ship does in no way reduce the benefits of orientation for other ships.

A *CPR* is a "[…] natural or man-made resource from which it is difficult to exclude or limit users once the resource is provided" (Ostrom 2005b, 79). Each person's use of a resource subtracts units from the resource whereby only a finite amount is available and the resource diminishes with consumption (Ostrom et al. 1994, 7-8; Aggarwal and Dupont 1999, 395). CPRs are thus characterised through a high substractability and the difficulty to exclude beneficiaries. One speaks about a CPR, if a community or a group of users defines the rules and regulation for the resource use. Thus, a well-defined group (a community) has the right of exclusion - the right to exclude non-community members from the use (Baland and Platteau 1996, 29). An example of a CPR is a commonly fished lake or pond that is used by several fishers, where excluding other fishers from the resource is not possible. The more fisher the smaller the benefit for each of them (assuming that the fish resources in the pond are finite) as they compete for fishing.

In contrast to a CPR, *open access* to a resource is characterised through a non-restrictive possibility to use the resource, meaning that institutional rules do not determine e.g. how resource units are to be appropriated - property rights are not defined at all (Libecap 1989, 115; Baland and Platteau 1996, 29). However, open access is also characterised by a situation, where property rights are defined, but not enforced, leading to a *de facto* open access situation. In situations with open access to resources, individuals have incentives to subtract more and more units, leading to an overuse or a destruction of the resource (Ostrom 2005b, 80).

The difficulty of excluding others (or high costs of excluding) from the benefits of a resource are found in PG as well as in CPR settings. This difficulty leads to a potential *free-rider* or *collective action problem* (Olson 1965). In these situations, those who want to provide a PG or service face the potential threat of free-riders that aim at consuming the good without contributing to its provision (Demsetz 1967, 354; Ostrom 2005b, 80). It is rational for the individual to take a free-rider position as the good or service is provided by others that carry the costs no matter if he contributes or not. This can lead to the Pareto-inferior situation of underinvestment in the resource and its maintenance and can affect the long-term outcomes achieved from the use of the PG.[69] The same is true for CPRs. Even when some individuals would be willing to reduce their use of the CPR, the collective action problem can persist as the benefits they generate are shared with others. Those might then not be willing to

[69] OLSON (1965) states that the gain to the individual must exceed the total costs of providing the collective good to the group. He also states that when public goods are provided, it is often because the costs of the good are sufficiently low in relation to its benefits so that one member of the group will ensure that the good is provided, even if others "free-ride" on his investment (Olson 1965, 22; see also Baland and Platteau 1996). This also means that smaller groups have an advantage to larger groups as they may be able to provide a collective good simply because of the attraction of the good to the individual members (Olson 1965, 36). In larger groups also the costs of organising (e.g. bargaining to come to an agreement) are higher (Olson 1965, 47).

make a private sacrifice for the benefit of everybody. This constellation can involve joint users of a CPR or providers of a PG into what is known as a "common dilemma", where there is an absence of well-defined property rights (Baland and Platteau 1996, 2).

However, the PG and the CPR dilemma differ in regard to predicted equilibrium points. In PG settings, every player or participant has a dominant strategy to defect (regardless of whether the other player cooperates or not, the dominant strategy is not to cooperate) so that the Nash equilibrium results. This means, no player will contribute to the PG, and finally the good will not be provided.[70] CPR settings are, instead, generally not characterised by the existence of a dominant strategy. Here, the optimal strategy depends on the number of agents operating on the commons (Baland and Platteau 1996, 30-31). Each user of the natural resource will e.g. appropriate from the resource as long as his individual marginal return exceeds his individual marginal costs. Increasing its appropriation with only considering its own marginal return and costs, the agent is reducing the benefit for other resource users - negative external effects arise. Based on CASAJUS AND TUTIC (2007), the following can be derived. The aggregated activity level (e.g. total amount of animals on a pasture) defines the total profit of the group. The share on this total profit an agent *i* can realise is proportional to his own activity level. Formally, the CPR problem can be written as the tripel (N, F, c): with *N* being the amount of players and *F(x)* being the output generated by the resource as a function of the aggregated activity levels of the agents *x*; with *c* being the constant marginal costs of the activity. The function F(x) is concave and differentiable. Further, there is an aggregated activity level $\bar{x} \in R_+$, so that $\frac{dF}{dx} > 0$ for all $x < \bar{x}$ and $\frac{dF}{dx} \leq 0$ for all $x \geq \bar{x}$.

Such a tripel induces a game $(N, (S_i)_{i \in N \setminus \{i\}}, (u_i)_{i \in N})$ in strategic form, whereby $S_i = IR_+$ represents the strategy set of player $i \in N$. The payoff function is then defined as follows:

$$u_i(x_i, x_{-1}) = \frac{x_i}{X} F(X) - c * x_i.$$

Thereby X is set: $= \sum_{i \in N} x_i$ and x_{-i}: $(x_j)_{j \in N \setminus \{i\}}$. The simple case of a quadratic function $F(X) = aX - bX^2$ is assumed, whereby a, b > 0. It is also assumed that a > c, which insures that in the Nash equilibrium and in the social optimum the CPR is also actually used.

The payoff function of a player $i \in N$ is then: $u_i(x_i, x_{-1}) = \frac{x_i}{X}(aX - bX^2) - cx_i.$

The efficient use of the CPR is given, when the marginal return from increasing the aggregated activity level is equal to the marginal costs:

$$\frac{\partial(F(X) - cX)}{\partial X} = a - 2bX^e - c \overset{!}{=} 0 \Leftrightarrow X^e = \frac{a-c}{2b}.$$

[70] The public good dilemma is well illustrated in the PD matrix in Section 2.2.2.

The following Figure 4 illustrates the CPR problem graphically.

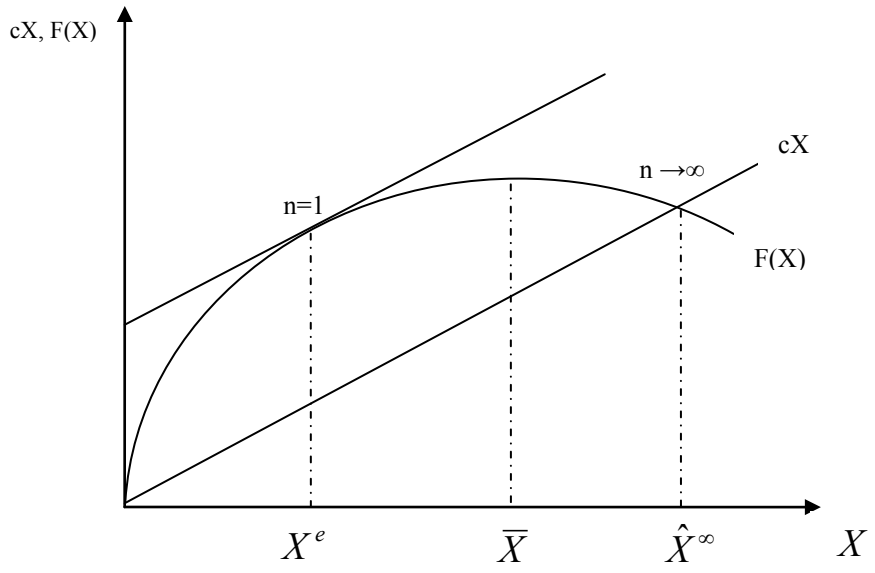

Figure 4: The CPR dilemma (Source: Casajus and Tutic 2007)

Comparing the efficient aggregated activity level X^e with the equilibrium $\hat{X}$ it becomes obvious that decentral coordination leads to an overuse of the resource. In the social optimum, X^e, the slope of the output function *F* is equal to the slope of the cost function *cX*. If a CPR is only used by one agent (n=1) there are no external effects and thus no inefficiencies occur. With a large number of agents (n → ∞), the Nash equilibrium $\hat{X}^\infty$ is characterised such as the average return - and not the marginal return - is equal to the marginal costs. With concave functions, the marginal return is always smaller than the average return so that there is an overuse of the CPR. The intersection of the return and the cost function are on the right hand side of the social optimum. With a decreasing group size the aggregated activity level $\hat{X}^n$ moves closer to the social optimum (Casajus and Tutic 2007).

Many problems including air and water pollution, overfishing, excessive groundwater use and overpopulation can be described as common dilemma situations (Gintis 2000, 257). These dilemmas can also concern many different aspects of natural resource management, including provision, assignment, or maintenance problems with each differing from one resource to the next. Probably most famous is the example used by HARDIN in the "The Tragedy of the Commons" (1968). He is using pastures as an example for a CPR analysing the incentives of farmers to free-ride in a local management situation. Each farmer is tempted to put an additional animal on the pasture, but thereby he is reducing the value of the commons to the group as a whole.[71] In this dilemma situation,

[71] HARDIN (1968) referred to the region of an English village that belonged to the villagers who were permitted to graze their animals on these commons.

individuals use more resource units when acting independently than they would if they could find some way of coordinating their activities (Ostrom 2005b, 80). It is thus often assumed that such a good must be provided by the state or privately to prevent the common dilemma. HARDIN, for example, comes to the conclusion that local users alone are not able to prevent the dilemma. He states the only solution to prevent the overuse is introducing either private or state property (Hardin 1968, 1244-45). Thus, some centralised entity, such as a national government or a private agent, has to step in to prevent the tragedy by regulating the common. However, creating private or state property rights in the resource is not always beneficiary or satisfactory (Demsetz 1988, 23; Baland and Platteau 1996).[72] It can restrict access of people that depend on the resources to generate an income and compensation payments to those people might be difficult to realise. At the end, the community as a whole may be better at controlling resource use than a single owner (Libecap 1989, 5; Gintis 2000, 32).

Today, many different disciplines contribute to the study of the commons, including social anthropology, sociology, economics and law. These studies focus on different aspects of the dilemma situation using diverse methods examining the factors that enable local user groups to manage CPRs over long horizons in a sustainable manner. Already in 1990, OSTROM defined eight design principles that influence the user's ability to successfully manage their local resources. These design principles are 1) clearly defined boundaries, 2) congruence between appropriation and provision rules and local conditions, 3) collective-choice arrangements, 4) monitoring, 5) graduated sanctions, 6) conflict-resolution mechanisms, 7) minimal recognition of rights to organise, 8) nested enterprises (Ostrom 1990). In his example, HARDIN (1968) disregarded these factors and was actually referring to an open access situation instead of a pasture that is common property of the farmers. He also revised his first conclusion in "The Tragedy of the Commons" (1968) in many later articles and stated for example "[…] the way to avoid disaster in our global world is through a frank policy of 'mutual coercion, mutually agreed upon.' Under conditions of scarcity, ego-centred impulses naturally impose costs on the group, and hence on all its members" (Hardin 1998).

Many local communities established ways of self-organising and self-governing to prevent overexploitation of the commons (see for example Ostrom 1990). In many cases, however, decentralisation is also implemented although local institutions might not have the strengths and capacities to secure an efficient and sustainable management of the natural resource base due to an erosion of their traditional rules and regulations (Ngaido and Kirk 1999). Further, DEINIGER AND KIRK

[72] BALAND AND PLATTEAU (1996) show that to be efficient the privatisation process must be perfect and complete so that it eliminates all the externalities involved in the exploitation of the resource. They argue that this is often not possible in reality (e.g. water resources) and that privatisation can create new externalities leading also to an unsustainable use (Baland and Platteau 1996, 41). Government policy even often make the situation worse as the underlying social connections on which local regulations are based can be crowded-out (Alston and Mueller 2005). TAYLOR (1987) also states that there is no necessary reason why transaction costs should be greater in CPR setting in contrast to the private or state property.

(2003) explain that many of these state-driven attempts to assign property rights lead to conflicts, overlapping property rights and to the exclusions of user groups, often the marginalised and poor. Complementary means such as training and a throughout implementation of decentralisation as well as the development of functioning land and credit markets are necessary in order to ensure an inclusion of all user groups (Deininger and Kirk 2003).[73]

Besides the property rights system in place, collective action is considered as the other main factor influencing the sustainable resource use. In order to answer the second research question posed by this research it is important to investigate the factors that influence successful collective action and thus the natural resource management. *Collective action theory* examines factors that enable (and disable) successful coordination of participants in action situation (Sandler 1992). Collective action can be understood as an "[…] action taken by a group to achieve common interests" (Marshall 1998, 86). In other words, these groups are characterised by a shared engagement in activities to reach common objectives. Participation in collective action can be voluntary or obligatory, active and direct or organised through an organisation, permanently institutionalised or ad hoc and unorganised. Formal agreements on collective action are found as well as informal arrangements (Di Gregorio et al. 2008). In the process of interacting with each other, people develop social customs and rules and thereby structure the actions of individuals. Through this form of cooperation, PG provision as well as secure access to benefit streams derived from resources can be facilitated. Furthermore, collective action can be a substitute for missing markets and a way to overcome common dilemma situations. Property rights play a key role for collective action within CPR systems as they can reduce the transaction cost of cooperation and offer a secure basis for sustainable management measures within the user group.[74] Likewise, collective action may enable CPRs to be more equitably and sustainably used (Di Gregorio et al. 2008, 15).[75]

Group formation and dynamics, power relations as well as trust and leadership are important factors that influence collective action structures and cooperative behaviour in natural resource management (Baland and Platteau 1996).[76] In action situations, where collective action is required for the provision of PGs or the sustainable management of natural resources, different factors influence the likelihood

[73] BALAND AND PLATTEAU (1996, 43-47) show that when the basic assumption of perfect markets is given up (as in reality this is seldom the case) also private property rights can lead to inefficient outcomes.
[74] Note that ALCHIAN and DEMSETZ (1973) state that communal right systems raise transaction costs by creating a free-rider problem. This is, however, here associated with an open access situation.
[75] Institutions (such as collective action and property rights) must be seen as dynamic. They undergo transformation, adaptation, evolution and change (Shepsle 1989, 141). The distribution of rights and the forms of collective action or how they are interpreted and enforced will change over time - responding to political transition, changing governance patterns and evolving natural environmental settings.
[76] It is essential to examine how decisions are made in regard to participation, monitoring, enforcing agreements and resulting distribution of benefits and costs. Rules are an important part of collective action. Collective action arrangements can be instrumental in developing rules for resource use, to monitor their compliance and to sanction violations. Collective action is thus a means to coordinate individuals' activities (Meinzen-Dick and Knox 1999, 45-47).

of successful collective action.[77] Even when there is cooperation in repeated interactions, this cooperation is usually less than perfect and often breaks down (Gintis 2000, 129). Specific attributes of the community can enhance the ability to cooperate. SANDLER (1992), for example, argues that collective action is more likely the smaller and the more homogenous (in endowments and preferences) the group (Sandler 1992).[78] Collective action also increases with e.g. homogeneity of caste, kinship, religion and ethnicity and relies on trust and family (Grootaert 1999, 54; Kähkönen 1999).[79] Social capital as "the norms and networks" that facilitate collective action (Woolcock 1998, 3) plays a prominent role in successful collective action arrangements. When the appropriators from a CPR share a common set of norms and values, practising reciprocity, it is rather likely that they develop adequate rules and norms to govern resources (Taylor 1987). Further, then the costs of developing monitoring and sanctioning mechanisms are relatively low.[80] In contrast, if the appropriators from a resource come from many different communities and are distrustful of one another, the difficulty of designing and sustaining effective rules is increased (Ostrom 2005b, 27). In addition, communication helps achieving a common understanding of the problem faced and discourse frequently generates ideas concerning various ways of coping more effectively with a problem. It supports the exchange about what norms individuals share or do not share and whether sufficient trust exists that individuals can adopt plans of actions that depend on trustworthy behaviour. Thus, trust and reciprocity play important roles in regard to successful collective action (Ostrom 1998, 6-10). Also, monitoring and punishment of free-riders are essential for sustainable collective action. In many field settings, participants have developed many kinds of formal and informal ways of sanctioning rule breaking behaviour of defectors (Ostrom 2005b, 91). Additionally, it is of advantage when local institutions are nested within a system of institutions that acknowledge the collective activities and might provide support and institutional back-up (see for example Ostrom 1990).

Collective action can prevent the common dilemma. Many communities and groups manage to provide PGs and to develop rules and sanctioning mechanisms that enable them to use their natural resources sustainably (many case studies are synthesised in e.g. Ostrom 1990; Baland and Platteau 1996; Ostrom 2005b; Poteete and Ostrom 2008). The interplay between rules, institutions, property rights and resource users' characteristics for arriving at cooperative solutions that enhance collective benefits are also subject to non-cooperative Game theory analysing the common dilemma with its

[77] See for example the design principles of E. OSTROM (1990).
[78] OLSON (1965) argues that social incentives can make an individual to contribute to a collective action. These, however, operate only in groups of smaller size, where members can have face-to-face contact (Olson 1965, 62).
[79] GROOTAERT (1999) finds that a high density of associations in a village does not mean that villagers are better able to engage in collective action and that rather villages with a tradition of paying membership fees are more successful in organising collective action (Grootaert 1999, 47). KÄHKÖNEN (1999) however, concludes that the existence of other associations in the communities is a factor positively influencing the community-based approaches.
[80] Individuals build a system of reputation that is used as a reference for engaging in collective activities.

problems of coordination, leadership and monitoring.[81] The next section therefore presents common dilemmas examined with experimental economics, considering specifically PGs and CPRs. Further, trust games are presented as trust is considered to have an important influence on collective action.

2.3.3 Common dilemmas studied in games

The concept of an action situation can be depicted in mathematical games. Experiments show how action situations work and how changes in the structure of an action situation can lead to different outcomes (Ostrom 2005b, 69). In an action situation, participants select actions from a set of alternatives. These situations are characterised by seven components (compare section 2.3.1). All (1) *participants* of a specific action situation must have some common information about the situation in order to actually be in the same situation. In some action situations, the (2) *positions* of participants are unequal, allowing e.g. some to have power over others.[82] The set of available actions are the means that participants have in order to achieve particular (3) *outcomes* (Ostrom 2005b, 32-33). (4) *Action-outcome linkages* describe the relationship between an action and its outcome.[83] A participant can have full, partial or a small degree of (5) *control* of a state variable and thus the outcomes. Participants can have complete or incomplete (6) *information*, whereby in situations with complete information each participant knows the full structure of an action situation (number of participants, positions, outcomes, actions available, the action-outcome linkages, information available to other players and everybody's payoffs). The (7) *costs and benefits* assigned to actions and outcomes can be thought of as the external incentives in a situation (Ostrom 2005b, 45-50).[84]

There is an extremely large number of components that create the context within which a game is played and many significant situations are too complex to be modelled as a simple game (Ostrom 2005b, 7). However, depicting simple situations (like social dilemmas) can be useful to understand the concept of an action situation (Camerer 2003, 9; Ostrom 2005b, 37). Social dilemmas can be found in economic, political and social life and always occur when the private returns are greater than the share of a joint return no matter what other participants do (Ostrom 2005b, 37).[85] All games presented here depict such social dilemmas. In the PG game, players in an action situation are faced with the decision whether to contribute or not to contribute to the provision of a PG. In the CPR game, a special form of

[81] See for example BALAND AND PLATTEAU (1996) for a (game theoretical analysis) of CPR problems.
[82] Positions can be e.g. players, voters, buyers, sellers, group leader, police officer etc. A participant may simultaneously occupy more than one position. In most situations the capability to take particular actions is assigned to a specific position (Ostrom 2005b). Where positions are institutionally legitimised they may be called "authority" (e.g. police officer) (Parsons 1940, 191).
[83] In a *certain linkage*, every available action is linked directly with one and only one outcome. *Risky or uncertain linkages* involve one-to-many relationships. When institutional arrangements offer a wide range for choice, and when the outcomes of each individual depend on the actions of others, the decision situations is characterised through uncertainty. A Nash equilibrium is a method for predicting the likely action-outcome linkages (Ostrom 2005b).
[84] Game theorists use utility-values in representing an outcome and only rarely decompose this into component costs and benefits (Ostrom 2005b).
[85] HOBBES (1651) was already dealing with social dilemmas and many other philosophers have been and are engaged in the debate.

a PG game, players can overuse and destroy the resource, when e.g. the group as a whole appropriates more than is desirable in regard to the sustainability of the resource. An asymmetric social dilemma is presented by the trust game, where one player takes his decision first and thereby puts trust in another one. All games isolate fundamental aspects of group behaviour when voluntary contributions are socially desirable but individually bad (Ledyard 1995, 120). The experiments thus contribute to various debates about alternative organisational arrangements that serve the interests of the community. However, they also question the nature of humans, whether they are cooperative or selfish, altruist or fair players (Ledyard 1995, 121). The following two sections will focus on the most important games in regard to PGs, CPRs and trust as they are of special interest for this research.

2.3.3.1 Public good and common-pool resource games

PG games are designed to depict problems associated with providing PGs like the voluntary payment of taxes or the contribution to team objectives. Game theory has also been extensively used for the analysis of CPR problems and these games depict problems associated with e.g. appropriation from natural resources or their maintenance.[86] While CPR and PG games are equivalent in regard to the homo oeconomicus model, the status quo in the PG game is the individual keeping all the money in the private account, while the status quo in the CPR game is that everyone appropriates as much as long as his marginal return exceeds his marginal costs. Both games are an n-person repeated PD (Gintis 2000, 257-258).[87] The general features of a PG or CPR experiment can be described according to an action situation: *n* symmetric subjects or (1) *participants*, all holding the same equal (2) *position* - PG provider (or CPR appropriator) are each given an endowment of *x*. They are told that each can choose to invest some or all of their endowment *x* in a PG. This is their set of action. Each will simultaneously and without communication put an amount between 0 and x in an envelope. The experimenter will sum the contributions up, double the amount and then divide this money among the group members. In the CPR game one would ask players e.g. how many days a month they want to harvest from the resource and how many days they rather use their time earning money in an outside option. If the appropriators decided to allocate a sufficiently large number of their available assets, the outcome they receive is less than their best alternative. Usually, the payoff for each possible combination of decisions is depicted in a table, which indicates the profits generated by each individual player. The (3) *outcomes* depend on what was contributed (appropriated) by each of the players. The (4) *action-outcome linkages* are obvious to all players as the contributions (appropriations) of all players determine the payoffs of each individual player. Each private investment in the PG (each non-appropriation from the resource) yields a return to each player in the

[86] The tragedy of the commons is often associated with appropriation problems (see for example Hardin 1968; Dietz et al. 2003). However, there are also problems concerning the provision and maintenance of CPRs.
[87] As in the PD, if no one cooperates to produce the PG, everyone is worse off than if they would have cooperated. However, using the PD for depicting CPR situations has been often criticised (see for example Aggarwal and Dupont 1999). Collective-action problems can be represented by many different game structures, e.g. the chicken and assurance game (Taylor 1987).

group. The players can each not fully (5) *control* their payoffs. They all have the same amount of (6) *information*, which is complete, but not perfect. They know the number of participants, their positions, the outcomes for each possible sum of contributions (appropriations), the actions available, the action-outcome linkages, and that this information is available to all other players.[88] The (7) *costs and benefits* depend on the decisions of all players (Ledyard 1995, 112; Ostrom 2005b, 81).

The external incentives in these situations lead to the game-theoretic prediction that no one will ever contribute anything to the PG (or that the resource will be overused). Each player will try to free-ride on the others as it is a dominant strategy to choose e.g. to contribute nothing because each token contributed yields only a fraction of each token to its contributor, no matter what the others do (Ledyard 1995, 112). The social optimum, where every individual contributes all, is presumably never reached. However, empirical data contradicts standard economic and Game theory. Cooperative behaviour was observed in many experiments. Already the first experiments conducted by BOHM (1972), DAWES, MCTAVISH and SHAKLEE (1977) as well as MARWELL and AMES (1979) revealed evidence that not everyone free-rides all the time.[89] In all three experiments subjects considerably contributed to the PG even if their own self-interest ran counter.

These experiments mark the beginning of a more systematic research for factors that influence the cooperation level. DAWES, MCTAVISH and SHAKLEE (1977) showed in their first experiment that when players have the possibility to communicate, cooperation considerably increased with 72 percent contributing to the PG good when relevant communication occurs, in contrast to only 31 percent without communication (Dawes 1980, 185). ISAAC, MCCUE and PLOTT (1985) also reported that the increase in contributions in the communication treatment "[…] is small but […] appears to be stable" (Isaac et al. 1985, 67). Similarly, the players at ISAAC and WALKER (1988) averaged contributions greater than 80 percent when subjects communicated (Isaac and Walker 1988, 594). Monitoring the discussions of players, they concluded that communication helps the group to understand the implications of different allocations and to build credibility to expected contributions of group members (Isaac and Walker 1988, 602). In a follow-up experiment, they found that even when communication is costly the groups still reached contribution levels of 90 percent of the maximum in

[88] Classical Game theory assumes that all knowledge is common knowledge, except for specific pieces of information that are known asymmetrically. Everyone knows the rules, everyone knows that everyone knows the rules, everyone knows that everyone knows everyone knows the rules, and so on ad infinitum (Gintis 2000, 13). Here, it is assumed that players know the shape of the function linking actions to outcomes and that they know that they are equal in assets and opportunities.

[89] BOHM (1972) asked subjects how much they would be willing to contribute to see a half-hour TV show. DAWES, MCTAVISH and SHAKLEE (1977) asked subjects to mark an X or an O on a card. When choosing an O, earnings will be US$2.50 minus US$1.50 fine for every person who chooses X. If they choose X, earnings would be US$2.50 plus US$9.50 minus US$1.50 fine for each person who chooses X. MARWELL AND AMES (1979) asked undergraduate students to contribute to a public good, which returned money to the group. Beyond a given provision point, the return from the investments was much higher per token invested in the PG than kept.

rounds four to ten (Isaac and Walker 1991, 279).[90] These findings have been replicated many times by other researchers.[91] They have also been shown to be relevant in CPR games (see for example Ostrom and Walker 1991; Ostrom et al. 1992; Muller and Vickers 1996; Cardénas et al. 2003; Bischoff 2007). OSTROM, WALKER AND GARDNER (1992) depicted a CPR problem where multiple appropriators withdrew resource units from a CPR. They found that communication led to almost perfect cooperation of 99 percent of the maximum possible, although people were not able to make binding agreements (Ostrom et al. 1992, 410). Simply promising to reduce their appropriation levels from the CPR led players to change their behaviour.[92] CARDÉNAS (2000; 2003) conducted extensive field experiments with more than 200 villagers in rural communities in Colombia. The villagers are users of local forests (extraction of firewood, natural fibres and timber) and depend heavily on the forest products. In the experiment, subjects decided how many months they want to spend in the forest gathering wood products in contrast to using their time otherwise. Without communication villagers substantially over-harvested the resource (spent too many months in the forest) and received on average only 57.7 percent of their optimal return. With face-to-face communication groups cooperated more and reached on average 68.5 percent of maximum (Cardénas 2000, 316). CARDÉNAS found variations of contributions among different groups, which he explained to be higher when most members of the groups were already familiar with common resources. Those groups used the possibility to communicate more effectively than the groups where most members were dependent rather on their own assets. He also found that social distance and group inequality based on the economic wealth of the people seemed to have reduced the effectiveness of face-to-face communication (Cardénas 2000, 317; 2003).

In the games of OSTROM ET AL. (1992) subjects faced the same decision for a series of periods - they played repeatedly. KIM and WALKER (1984), ISAAC, MCCUE and PLOT (1985) as well as BANKS, PLOT and PORTER (1988) first examined the effects of repetition in their PG experiments. In all games, one can observe significant underprovision and the free-riding phenomenon as the game progresses. At ISAAC ET AL. (1985) first period contributions yielded a group payoff of 50 percent of the maximum on average. However, by the fifth period the average number of units provided has dropped to nine percent of the maximum possible (Isaac et al. 1985). KIM and WALKER (1984) played the game over a couple of days with subjects being asked to make decisions at different days and found sharply diminishing contribution with succeeding rounds, although there were some positive initial contributions (Kim and Walker 1984). However, there are also experimental findings reported where repetition had no significant effect on free-riding (Ledyard 1995, 147). ANDREONI (1988) aimed at

[90] Such communication is called *cheap talk* and can, according to standard Game theory, not lead to a distinct subgame perfect equilibrium.
[91] SALLY (1995) analysed PD experiments from 1958 until 1992, compiling relevant factors for the level of cooperation.
[92] Returns increased successfully and were close to 100 percent in a ten token experiment. In a second experiment with 25 tokens, performance also improved but defection was greater with 73 percent of maximum available returns reached with a defection rate of 13 percent (Ostrom et al. 1992, 410).

testing if the subjects' learning might account for the decrease in cooperation in repeated games. He designed an experiment where the whole process is repeated with the same subjects but with different group compositions in order to prevent subjects to signal future behaviour (and thus players were not able to play strategically). The findings showed that, once again, cooperation declined with the game progressing. He concluded that subjects do not seem to learn free-riding but rather know the full decision possibilities right from the beginning of the game (Andreoni 1988, 300).

OSTROM ET AL. (1992) further introduced "monitoring and sanctioning" as treatments in their design. Here, subjects were able to impose costs on other players by paying a fee, thus were able to "fine" defectors. Standard Game theory predicts monitoring efforts in this case to be zero.[93] However, the researchers found a significant level of punishment, which also decreased free-riding behaviour in the groups (Ostrom et al. 1992, 411).[94] Other experiments (see for example Dawes et al. 1986; Fehr and Gächter 2000) had similar findings with punishing opportunities being used to sustain cooperation, even when they were costly.[95] In the CASARI AND PLOTT (2003) design, players were able to inspect the decisions made by others at a set cost. Then, the harvesting decision of the subject became public information and a fine was imposed for each unit appropriated above the announced level. They conclude that "[…] about one-third of the agents are other-regarding to various degrees" (Casari and Plott 2003, 243). At CARDÉNAS, STRANLUND AND WILLIS (2000), subjects faced a situation where their conformance to the rule (a time limit on time spent collecting wood in the forest) could be monitored. When more time was spent in the forest, a penalty was subtracted from the payoffs. Participants increased their harvesting levels with this externally imposed sanctioning mechanism in contrast to the treatment with no rule but communication. The imperfect monitoring (with a low probability of 1/16 to get monitored) was "not as good" as communication. Subjects lost their "group-orientation" when the external enforcement mechanism was introduced - the external rule crowded out cooperative behaviour (Cardénas et al. 2000). Also BOHNET, FREY AND HOOK (2001) state that external rules imposed on citizens can crowd out intrinsic motivation and can provoke a decline in cooperation in contrast to voluntary agreements. Their findings also support the thesis that externally imposed rules that are seldom enforced are the worst in respect to cooperation levels (Vollan 2008).

[93] Since fining costs the individual who uses it but the benefits of increased compliance benefit the whole group, the only subgame perfect Nash equilibrium in this game is for no player to pay the fee, so no player ever punishes for defecting and all players defect by contributing nothing to the PG.

[94] Sanctioning was higher when the costs of sanctioning were lower as well as when the ratio of the fine to the fee is higher. When subjects were given a single opportunity to communicate prior to the implementation of sanctioning, free-riding decreased further (Ostrom et al. 1992, 411).

[95] The design of OSTROM ET AL. (1992) allowed players to engage in strategic behaviour. The costly action against defectors could increase cooperation in future periods, which would in turn yield a positive net return in later rounds. FEHR AND GÄCHTER (2000) set up a similar game, but ensured that group composition changed in every period. Costly retaliation could not lead to benefit to those who punish and thus building a positive personal reputation was not possible. Nonetheless, punishment of free-riding was prevalent and gave rise to a large and sustainable increase in cooperation levels (Fehr and Gächter 2000, 482).

It seems that in regard to gender differences, the results are ambiguous. Two studies found that females tend to contribute more than males. However, in the first experiment the gender differences were only relevant in the communication condition (Dawes et al. 1977, 10). In the second study, the higher cooperation levels of women vanished with the game progressing (Mason et al. 1991, 227). Contrary, BROWN-KRUSE AND HUMMELS found that men contributed significantly more to the PG than women (Brown-Kruse and Hummels 1993). Other experiments (see for example Poppe and Utens 1986; Orbell et al. 1992) found no gender difference in contribution rates (Ledyard 1995, 160).
Researchers also tested the influences of leadership on group outcomes and find that with a randomly assigned leader, contributions to the PG can increase (Moxnes and Van der Heijden 2003; Gächter and Renner 2004; Güth et al. 2004). However, according to LEVATI ET AL. (2007) the contributions to the PG increase only when initial endowments of all players are common knowledge. Leaders also contributed significantly more than followers (Levati et al. 2007). VAN DER HEIJDEN ET AL. (2006) tested team production and found that under the leader treatment in comparison to the equal team member treatment, the team performance was significantly better (van der Heijden et al. 2006, 10).

In other experiments, many additional factors to those presented here were identified that influence the cooperation level.[96] Treatments that led to an increase in cooperation and a decrease of free-riding behaviour include communication, the opportunity to punish defectors and a sense for group membership. Additionally, homogeneous interest, little information, no experience, small groups and high marginal payoffs from contributing caused an increase in contributions (Ledyard 1995, 172). In contrast, free-riding increased with repetition as well as badly monitored external sanctions can even crowd out cooperative behaviour. Further factors identified leading to a decrease in cooperation are heterogeneous payoffs and endowments (especially when this is common knowledge), experience, and low marginal payoffs (Ledyard 1995, 172).

To summarise, several experiments have shown that subjects contribute to PGs and behave cooperative in CPR settings even though non-contribution is a dominant strategy. Selfishness is not as ubiquitous as expected. However, contributions are significantly lower than the social optimum and cooperation does not seem to be stable. Actually, a full range of behaviour exists from fully selfish to fully altruistic. Some act perfectly cooperative others perfectly selfish while there are also players that defect occasionally.

2.3.3.2 Trust games

Trust can be defined as "[…] the willingness of a party to be vulnerable to the actions of another party […]" (Mayer et al. 1995, 712). It is "[…] the expectation that arises within a community of regular,

[96] LEDYARD (1995) identified 19 variables from PG experiments that are having an effect on the level of contributions. He groups these into three main categories: the *environment* (e.g. numbers, initial information structure or gender), *systemic variables* (e.g. fairness concepts, altruism or risk attitudes) and *design variables* (such as structured communication). The variables in the last category are aspects of institutional design.

honest, and cooperative behaviour, based on commonly shared norms […]" (Fukuyama 1995, 26). There are at least two parties involved in a situation involving trust and one person expects some certain behaviour of another person, which makes him vulnerable (Mayer et al. 1995; Rousseau et al. 1998). In common dilemma situations, trust concerns the question whether an individual is willing to cooperate having the expectation that the other will reciprocate (Ostrom 1998, 12).

The trust game, replicated and extended many times, can also be described as an action situation (Ostrom 2005b, 71). Two *participants* (1) play the game. The two *positions* (2) are the "investor" and the "trustee" and are unequal. The player's identity will remain anonymous to the other player. The investor is given x tokens at the beginning of the game. He then decides if and how much of x, he wants to give to the trustee. The amount sent y will be tripled by the experimenter. The trustee then decides how much of the funds z to return to the investor. This is their set of action, which is sequential and asymmetric.[97] The *outcomes* (3) are the size of the funds allocated to the two players in light of the decisions they have made. The *action-outcome linkage* (4) is the amount invested in the trustee that yields a rate of return (supplied by the experimenter). Neither the investor nor the trustee can fully *control* (5) their outcomes. The *information* (6) available to both players is the full tree of possibilities. *Potential payoffs* (7) are affected by the rate of return. The payoffs of the investor is $(x-y) + z$ and for the trustee is $y-z$, assuming that the investor sends something in the first place (zero otherwise). The amount sent y by the investor can be used as a measure of trust. The amount sent in relation to the amount returned y/z by the trustee as a measure of trustworthiness. Although simple in its design, the game depicts the essence of trust and reciprocity (Ostrom 2005b, 71-72).

In the trust game, the assumption is that a self-interested trustee who wants to maximise his returns would return nothing. The investor would expect this and would not send money to a stranger in the first place. Like in all social dilemmas, this prediction leaves all participants worse off than they could have been. Also here, the players reach inefficient collective outcomes, when playing completely in their self-interest. However, also in the trust game, results show that behaviour in the experiments is not fully consistent with what is predicted by standard non-cooperative Game theory (Kugler et al. 2007, 3). About half of the first-movers offer some money (and trust), while three in four of the responders give some back (and are trustworthy) (Siegfried 2006, 105). In 1995, BERG, DICKHAUT AND MCCABE designed the first trust game and examined the likelihood that an individual will take a costly action because he places trust in a second individual. They found that 30 of 32 subjects in group A (investors) sent money to their unknown counterparts in group B (the trustees) (5.16 US$ on average) and 18 trustees (of 30) returned more than one US$ (4.66 US$ on average). Eleven trustees even sent more back to the investor than they received. High investments yielded a high return, but those investors who sent less than five US$ received a negative net-average return (Berg et al. 1995, 131). On average, those investors who trusted the most were the only ones who left the game with

[97] The game is similar to the structure of a sequential PD.

more wealth than those who were less trusting (Ostrom 2005b, 72). Thus, also in trust experiments, the standard game theoretic assumptions of purely selfish behaviour could not be confirmed. FEHR AND ROCKENBACH (2003) introduced sanctioning opportunities in their design.[98] They found high reciprocity in the "no sanctioning condition" (79 percent). When the sanctioning mechanism was introduced, the highest return occurred when the investor refrained from imposing a fine. Very low trust levels were found when the investor indicated a high desired back-transfer and used a fine (Fehr and Rockenbach 2003, 138). The same effect is reported by FREY (1994), who found that external sanctioning was crowding-out intrinsic motivation (Frey 1994).

Many experimenters questioned different levels of trust and reciprocity among different countries and cultures investigating whether those levels have an influence on economic performance (see for example Knack and Keefer 1997; Buchan et al. 1999; Zak and Knack 2001). Further, GLAESER ET AL. (2000) wanted to see whether self-reported levels of trust correlate with behaviour. They found no statistically significant correlation between self-reported and experimental measures of trust (Glaeser et al. 2000, 833).[99] This experiment also showed that friendship increased the levels of trust (weakly) and trustworthiness (strongly), whereby social distance to the corresponding partner (e.g. race and nationality) led to a decrease of both trust and trustworthiness (Glaeser et al. 2000, 840-841).[100] Trust games have further been used to test many other effects, like gender, communication, and beliefs, as well as cultural, ethnic and racial differences. In regard to gender differences, there seems to be no differences between men and women in regard to trust. However, women seem to be more trustworthy if they were trusted in the first place (Vyrastekova and Onderstal 2005; Innocenti and Pazienza 2006).

The findings of these experimental studies give important insights for an institutional analyst (Ostrom 2005b, 77-78). They have shown, like the PG and CPR games, that people behave differently and that not everyone cheats all the time. An important finding from both experimental research strands is that external imposed rules do not lead to a higher level or rule conformance and trust, but rather lead to a decrease in cooperation levels. This challenges the standard recommendation that external sanctions are the best way to solve social dilemmas (Ostrom 2005b, 77).

[98] The investors could choose an opportunity to indicate a "desired back-transfer" (between zero and the full tripled amount). Further, they could choose a "fining option" that will reduce the trustee's payoffs when he does not send back at least as much as he specified as "desired back transfer".
[99] However, GLAESER ET AL. (2000) state that rather the questions whether the person trusts other people is an indicator for his trustworthiness (Glaeser et al. 2000, 833).
[100] COX (2004) and CIRIOLO (2007) argue that the result in GLAESER ET AL. (2000) may be due to a biased interpretation of the agents' behavioural decisions (Ciriolo, Emanuele 2007, 4). CIRIOLO (2007) used indicators about individual characteristics, respondents' past experiences (e.g. regarding crime, inequality, immigration.), and community features as measures of other people's perceived trustworthiness. He concludes that survey-based measures of trust can function as a reliable proxy for trust levels (Ciriolo, Emanuele 2007).

2.4 Conclusion

Activities and actions in social reality are complex. Thus, institutional analysts face severe theoretical and empirical challenges. The IAD is a framework that enables researchers to focus on different aspects of the institutional analysis at a time. It is composed of different variables that mutually influence each other. Action arenas are affected by exogenous variable, but actions are not entirely determined by them. In institutional analysis it is important to investigate how participants view rules, how they understand them and what impacts monitoring and sanction have on decisions taken by participants.

NIE and Game theory investigate the evolution, development and impact of institutions. Institutions are always present and enable humans in a complex and uncertain world to structure their social interaction. Rules, formal or informal, enable individuals to make assumptions about the behaviour of others and reduce the threat of opportunism. Further, institutions play an important role in reducing transaction costs and support contractual agreements. Also, property rights can reduce uncertainty of humans. Through well-defined property rights, restriction of access by other individuals can be secured as the owner has the right to prevent them to exercise the same right on the same property. PR further shape incentives for sustainable management of resources. When these resources are not effectively protected, investments will be less because future returns are uncertain (Ostrom 2005b, 78; Rubin 2005). Some resources are "commons" or CPRs where restricted access is not possible or where excludability problems can lead to the problem of free-riding. This can end in a common dilemma and natural resource overexploitation and degradation. However, empirical research found many examples where local users managed their CPRs successfully. Several factors enhance the likelihood of successful collective action. For example, when people communicate face-to-face they are rather likely to reach a consensus. Monitoring and sanctioning also decrease free-riding as defectors have the risk to get caught.

Action situations can also be analysed in games. Here, the players find themselves in a dilemma situation. PG games as well as CPR games have shown that people do not act purely selfish. Even in simple games, a large number of choices about the action situation are made (e.g. the number of participants, the level of endowment or payoff and the possibility to communicate or not). Each of these choices represents a potential treatment or control. Many treatments have a significant effect on the level of contribution. Trust as a social norm, plays a key role in collective action. In the trust game, it was shown that a substantial amount of people trusts each other as well as trust is reciprocated. All the games presented are also played in the field with people embedded in their cultural environment and facing choices they know from everyday life (see for example Cardénas 2000; 2003; Carpenter et al. 2004; Vollan 2008). These games support other research methods in the field and offer valuable insights in the behaviour of individuals and groups towards natural resource management.

3 Methodology

3.1 Introduction

The following section gives an overview about the research methods applied during the field visit between August 2006 and November 2007 and during a second visit to Cambodia in September 2009. This section will focus on the action research design and processes as well as on the socio-economic survey. Thereby, in the first series of methods, the focus was placed rather on the exogenous variables that influence the action arenas (see the IAD in Figure 3 in section 2.3.1). However, also participants, interactions, outcomes and an evaluation of the project were taken into consideration while doing action research and implementing the survey. After having analysed the factors that mostly influence action arenas in the research sites, action situations were depicted in three games and hypotheses for the interactions between the participants and the outcomes of these interactions were developed. Their designs will be introduced in section six only. The experiments help getting an in-depth understanding about action arenas, the interactions and the outcomes derived from those interactions.

Table 16 in the Appendix provides an overview about the overall research schedule. In an initial phase of research from July 2006 till August 2006 relevant stakeholders on national, regional and local levels in Cambodia and Vietnam were identified and consulted in order to get an overview about underlying institutional arrangements, property rights systems and collective action activities. During this time, primary sources and secondary literature studies as well as workshops with primary stakeholders, i.e. farmers in different communities, were conducted.

Between September 2006 and November 2007, field research was conducted on a local level in the adjacent provinces of the Mekong Delta located along the border of Cambodia and Vietnam. After a situational analysis in seven communities in the Delta, four communities (two in Cambodia, two in Vietnam) were selected as case studies. In close cooperation with villagers, community members, local authorities, government staff and representatives of civil society, the data collection then took place. The experiments were conducted between July and October 2007. In a final phase between October and November 2007, institutional arrangements were again discussed with the relevant stakeholders. In September 2009, a follow-up visit was conducted in order to complete the discontinuance analysis in Cambodia. All tools were implemented on-site/on-farm and technologies were developed in real conditions based on the people's access to resources and the characteristics of the communities. Most of the time the village chief or a villager offered his house for the discussions, tool implementation and experiments. The interviews were conducted wherever the interviewees felt comfortable, most of the time at their own homesteads.

The research was conducted interdisciplinary in close cooperation with WorldFish, the FiA in Cambodia and the Research Institute for Aquaculture No.2 (RIA2) in Vietnam as well as in collaboration with IFPRI. The research concerned multiple units of analysis, including the community, groups and individual behaviour. It was designed as highly participatory, doing not only justice to the project goals, but considering the local knowledge of the natural resources, of the technical options and of the formal and informal institutions as the most important source of information for the project as well as for this research. The investigation required an extensive amount of field work in order to build a level of trust between the farmers and the researcher and to implement the diverse range of participatory methods and tools.[101]

The following section starts with the introduction of the research paradigm and the choice of methods including the justification of those (3.2). In section 3.3 the research procedure will be introduced, describing in detail the methods used, including the site selection and sampling methods, the tools used during the action research as well as the survey design. As mentioned, the designs of the experiments will be presented in section six, followed by the results. Section 3.4 suggests ethical considerations that need to be taken into account when doing social research and the last section (3.5) summarises the section.

3.2 Research paradigm and methodology

A *methodological pragmatism* underlies this research as research paradigm and a *mixed method approach* was applied. *Pragmatism* embraces the points of view of both (post-)positivism and constructivism. It avoids the use of metaphysical concepts (e.g. truth, reality) and it presents a very practical and applied research philosophy (Tashakkori and Teddlie 2003; Baert 2005, 130). The mixed methodologists' belief is that qualitative and quantitative methods are compatible and that the incompatibility thesis of (post-)positivism and constructivism stating that these methods are incompatible due to the incompatibility of the paradigms underlying those, is rejected (Howe 1988; Tashakkori and Teddlie 2003, 7).[102] In this research, it is assumed that the research is influenced by the researchers' values, by the theory applied by her and that the understanding of the reality is constructed. The approach chosen provides the opportunity to present a greater diversity of views and confirmatory as well as exploratory questions can be answered simultaneously (Tashakkori and Teddlie 2003, 6 & 14-15).

[101] Also, the project implementation required the technical project staff to be very much present in the field sites to be available for technical and other support.

[102] The *constructivist paradigm* assumes that there are multiple realities (relativist ontology) and that knower and subject create understandings (subjectivists epistemology) (Denzin and Ryan 2007, 588). The *positivist paradigm* assumes that there is one reality out there to be studied and understood. The post-positivists argue that reality can never be fully apprehended, only approximated (Guba 1990, 22). The constructivist paradigm is rather represented in the action research applied, the positivism paradigm by the experiments and survey approach.

Mixed methods studies use qualitative and quantitative data collection and analysis techniques in either parallel or sequential phases.[103] Information from different data sources about the same social phenomena are combined to validate findings of from each method (Tashakkori and Teddlie 2003, 7; Creswell and Plano Clark 2007, 9). The methods are mixed in the method section of the study only and are frequently either qualitative or quantitative in regard to the questions they ask.[104] Thus, the specific decision on what method - quantitative or qualitative - to be used only depends on the research question answered at that specific stage of the research (Tashakkori and Teddlie 2003, 11).

The mixed method approach has been applied here in order to incorporate the strength of both quantitative and qualitative approaches and to reduce some of the weaknesses of single methods.[105] Qualitative studies involve the collection of a variety of empirical materials (case study, personal experience, interview, observational and historical texts) (Denzin and Ryan 2007, 580) and aims at understanding the research issues in terms of the meanings people bring to them (Flick 2006, 6; Denzin and Ryan 2007, 580). Qualitative data can refer to persons' lives, experiences or cultural phenomena (Strauss and Corbin 1998, 11). Data is not "measured" in terms of quantity, amount, and intensity or frequency. In contrast, quantitative studies emphasise the measurement and analysis of causal relationships between variables (Denzin and Ryan 2007, 582-83) with the aim to isolate "causes and effects" as well as "measuring and quantifying phenomena" with the purpose to generalise findings (Flick 2006).

Another advantage of the mixed methods approach is that it suggests further investigation about the underlying situation when data from different situations is contradictory, indicating that the issue is not fully understood at this time. Thus, the researcher is able to obtain a more complete picture of human behaviour and experiences (Morse 2003, 189; Flick 2006, 40; Creswell and Plano Clark 2007, 7-9). Moreover, the approach supports obtaining a holistic understanding results from noting trends and generalisations as well as in-depth knowledge of participant's perspectives (Creswell and Plano Clark 2007, 33). With the choice of methods this investigation receives depth (mainly through qualitative methods) and breadth (mainly through the use of quantitative methods).

The first component applied in this research is *action research*. The basic idea is to involve farmers in the research and in the project in order to generate locally appropriate technological and institutional solutions. Done in a participatory manner, it empowers local people and facilitates social learning. The

[103] TASHAKKORI AND TEDDLIE (2003) even declare the mixed method approach as the "third methodological movement" and consider it to be more than the sum of combining qualitative and quantitative methods.
[104] Mixed methods relate to the data collection/operations stage only, while mixed model studies concern all three stages (nature of investigation, data /operations, analysis/inference) (Tashakkori and Teddlie 2003, 29).
[105] DENZIN AND RYAN (2007) criticise the mixed methods approach in its presumptions of a methodological hierarchy (with quantitative at the top) and state that it excludes stakeholders from active participation in the research process. However, in this research this hierarchy is avoided and special emphasis is placed on the stakeholders' participation.

role of the researcher is rather facilitating the research process (Gonsalves et al. 2005, 8). The respondents can provide their insiders' views, their knowledge about farming systems as well as their understanding of the situation and the processes in regard to the social, institutional and economic environment. This ensures that the CBFC project is designed in a way that responds to needs and opportunities identified by users themselves and that the technological and institutional options build on local knowledge and local resources. It also helps identifying relevant institutions that might otherwise be overlooked, as well as information on rules, norms, and attitudes that have a strong bearing on collective action. The qualitative data gathered during the first year of field research, provides the basis for the quantitative experiments established and implemented in a later phase of the research.

A second component of the mixed method approach was the data collection with a standardised questionnaire. The *survey design* provides quantitative descriptions of trends, attitudes, or opinions of the population by studying a sample of that population. From sample results the researcher generalises or makes claims about the population (Creswell 2003, 153). The data gained from the survey complements the findings from action research, but offers are more rapid turnaround in data collection. It supports the attempt to quantify some of the issues covered within the action research. Incorporating semi-structured parts, the survey also provides more breadth including larger number of project participants and non-participants. Both quantitative and qualitative data were collected, providing descriptive and explorative data with a broad range of issues captured in order to receive a holistic picture of the HHs' wealth status and to document important aspects of the socio-economic activities in the communities. Further, many aspects were captured in the survey that, due to sensitivity concerns, could not be collected in participatory action research sessions (e.g. HH indebtedness).

Experimental economics, as the third component of this research approach, is used in order to further investigate the complex decision situation farmers faced in the research communities. In experimental situations, with money awarded to the players, decisions of players in regard to the provision of PGs or the appropriation from CPRs were analysed. The basic intent was to test the impact of a treatment on an outcome, controlling for all other factors that might influence that outcome (Creswell 2003, 153-154). Based on the findings from the action research, three main research issues were identified for further analysis in an experimental setting. Thus, field experiments were developed in order to test several hypotheses about villagers' behaviour in regard to a) the provision of PGs in the communities, b) the use of their CPRs as well as c) trust and trustworthiness. The PG and CPR games were further framed with the information set adapted to the local decision situation the Cambodian and Vietnamese participants usually experience in their real life. With the implementation of these two games the contribution and the appropriation problem in the action situation were separated. In the PG game, players faced the decision situation whether to contribute to a PG or not. In the CPR game, the players

had to decide how much to appropriate from a commonly used pond. The trust game was played in the field as well, however, it was not framed but rather represented an abstract decision situation for the players (e.g. the information set was not adapted to the local conditions). Here, players' trusting and trustworthy behaviour is analysed while also yielding monetary payoffs to the players depending on how decisions are taken. Finally, the trust game was implemented to receive data about trust within the community as trusting relationships in the community are considered as a facilitating factor in regard to collective action. All games were complemented with questionnaires in order to receive details about the participating persons and to test for understanding of the decision tasks.[106]

The idea of combining the described methods also results from validity concerns.[107] The action research results provide locally specific data. Results differ from site to site. This was considered as important in the project context as the research wanted to understand local conditions and factors that support the project implementation. The questionnaires where used with a larger sample, allowing the standardised data to be more easily compared between the sites and thus it provides a means for higher generalisability. The data received by conducting the experiments complement the data from action research and the surveys. However, they are also giving a precise picture about the level of cooperation in a real decision situation, investigating actual human behaviour that could not be provided by the other methods. Lab experiments usually have a high internal validity as the controlled conditions in the lab provide greater confidence in the internal validity of data. The external validity is thus partly limited. However, field experiments (see for example Cardénas et al. 2000; Cardénas 2003; Henrich et al. 2005) are designed to increase external validity with a minimal sacrifice of the internal validity (Loewenstein 1999, 26).[108] The questionnaires used with the experiments increased the internal validity and an exclusion of other causal relations was possible.

The following section 3.3 provides the detailed description of the research procedure of the action research and the survey.

---

[106] All experiments were conducted in cooperation with ANNE WEINGART from the University of Marburg, Germany.

[107] *Internal validity* refers to the ability to draw confident causal conclusions from the research and *external validity* to the ability to generalise from the research setting to other contexts (Loewenstein 1999, 26; Marczyk et al. 2005, 174). In other words, internal validity is high when the researcher can show that the independent variable as manipulated or measured does cause a difference in the dependent variable (and that plausible rival hypotheses are ruled out). External validity refers to the meaning of the study for other study areas (Roberts 1983, 328; Marczyk et al. 2005, 158-178).

[108] The presentation of the choice plays a crucial role for the individual decisions and theoretically equivalent choices may elicit different responses when presented in other terms (e.g. framed). Thus, the most reliable comparisons will be "within experiments" comparisons, in which the effect of a single variable can be assessed within an otherwise constant environment and "frame" (Roth 1995). Loewenstein (1999) also states that internal validity is often lacked in experiments conducted at different times and with different populations of the subjects and that "[…] observations are often not independent of one-another because subjects provide multiple observations and interact with one-another" (Loewenstein 1999, 32). In regard to the differences between conventional lab and field experiments and the implications for the results see also HARRISON AND LIST (2004).

3.3 Research procedures

3.3.1 Site selection criteria

The site selection process in Cambodia lasted for three months and followed several technical and institutional criteria. The requirements for suitable sites have been defined with aquaculture experts from WorldFish and the FiA. The following technical requirements needed to be met by the communities in order to be selected as a project site:

- Possession of fields that *flood more than 50 cm regularly,* but *not more than* two metres for at least three to four month of the year;[109]
- A *potential for aquaculture* in regard to e.g. soils and fencing possibilities;
- *Farmers or farmer-fishermen* and/or *experienced* in aquaculture want to participate;[110]
- Fields are not too remote from community HHs to protect the investments in fish (the more observable to as many HHs as possible the better).

The institutional criteria were considered as key as a technical solution was easier to be designed appropriate to the underlying conditions. The *institutional requirements* included:

- Communities are *interested in participating;*
- An *involvement of non-governmental organisations (NGOs)* who facilitate access to the community and support the implementation;
- *Access to markets* and some *experiences* in marketing of products is given, e.g. access to seeds and the ability to market harvest surpluses.[111]

Areas with *fishing concessions* were excluded as access to these sites would be restricted. Other criteria used for the site selections were that the project wanted to start with *small-scale activities*, involving small groups of farmers in relatively *poor areas*. However, those are likely to be away from main roads and economic centres, thus from markets. Therefore, a compromise between these two criteria was envisaged. It was also preferred to work close to the Cambodian-Vietnamese border to increase the *comparability* between the sites as the natural systems in the region are similar.

A preliminary step was an extensive consultation at the field level to identify appropriate communities and HHs. This involved 1) meetings with province/district level fisheries officials; 2) interviews with potential key informants (e.g. commune leaders, NGOs, fishers); and 3) personal observations by the researcher and project experts during site visits in the provinces. Maps of districts and communes,

[109] This reduced the sites to floodplain areas, irrigation systems or rivers.
[110] They are familiar with farming systems and thus more likely to use their agricultural system knowledge for aquaculture practices.
[111] The potential to market the aquaculture produce was considered as important as e.g. wild fish supply is likely to be high and prices low towards the end of the flood season when the harvests of aquaculture products will take place. Also, the provision of fingerlings by an availability of hatcheries in the area was a necessary criterion.

showing water coverage helped to identify the target communities. Fishing districts and communes were identified where the majority of the population has access to (seasonal) waterbodies and is engaged in fishing and fishing related activities. In taking this information into consideration as well as technical constraints (e.g. flood height, flood duration) a fair base was given for the selection of the communities. In accordance to the above mentioned criteria and the capacities of the projects staff, four Cambodian communities were finally selected as project communities in Cambodia in November 2006.

The sites in Vietnam had already partly been pre-selected by the national partner in Vietnam (RIA2). The consultation for further site selection was limited throughout the whole research phase. Sites were rather selected by RIA2 in cooperation with local officials from agriculture and aquaculture departments at different levels. Here, the first and main site selection criterion was that a suitable infrastructure for community-based aquaculture approaches in regard to technical feasibility is in place or can be easily developed. This also included criteria like flood characteristics and water quality as well as the availability of dikes and the possibility to fence up suitable sized areas of paddy fields. However, the willingness for cooperation from local officials as well as of farmers also played an important role in the selection process. In total nine project sites existed in Vietnam.

Table 3 provides an overview about the selected communities relevant to the research presented here as well as it indicates the methods implemented in each of the villages. The time of the implementation of the community-based project is also indicated. Two of the Cambodian villages (Thnal Kaeng (TK) and Pom Eith (PE)) were included in the case study analysis and economic experiments. Additionally, four Cambodian non-project communities were selected for the experiments.[112] In Vietnam two communities (E2 and Truong Phu B (TPB)) functioned as case study sites, with the survey as well as the experiments conducted in those as well.[113]

Village	Country	Project implementation	Case study sites	Survey	Experiments
Thnal Kaeng	Cambodia	2007-2008	√	√	√
Pom Eith		2007-2008	√	√	√
Svay Tiep		no project			√
Krosang		no project			√
Chrang Krohom		no project			√
Leuk		no project			√
Truong Phu B	Vietnam	2006-2007	√	√	√
E2		2006-2007	√	√	√

Table 3: Research villages and methods implemented

[112] These additional non-project sites were subject to earlier investigation by ANNE WEINGART who also implemented the trust games in these four communities in 2006.

[113] Table 17 in the Appendix provides an overview about all sites that were initially considered as research communities as they were participating in the project. The methods implemented in these villages are also indicated in the table, but are, however, not reported in this dissertation.

3.3.2 Action research procedures

The Participatory Action Planning Development Methodology (PAPD) (Sultana/ Thompson 2003) was used as an action research method and conducted with regard to site-specific conditions. The PAPD is a systematic approach to participatory planning, recognises diversity in livelihoods and works through a structured learning and planning process that focuses on common interest (Barr and Dixon 2001; Sultana and Thompson 2003). The process identifies the collective actions that are needed to arrive at preferred solutions, and determines potential impacts on different stakeholder and responsibilities for implementation, monitoring and evaluation. The method facilitates consensus building and the identification of options that take into account the interest of different stakeholders. The preparation of a detailed action plan is another key feature of the method (Sultana and Thompson 2003).

PAPD involves a scoping phase, a participatory planning phase, as well as an implementation phase (Sultana and Thompson 2003). In the first *scoping phase* of the PAPD, a situational analysis including a HH census was conducted in seven project communities. However, in this thesis only four will be reported. Farmers interested in participating in the project were invited to participate in the different research sessions. In a second phase (*participatory planning*), technical and institutional options/problems were discussed and directions for actions defined. Several meetings with the villagers were conducted in order to explain the project and research objectives. Also meetings with stakeholder representatives and secondary stakeholders where held to discuss feasible and respected technical and institutional solutions. The "fish culture groups" were established, who then developed their own detailed action plan (for example physical works, application of rules, monitoring) to implement solutions agreed on. In the *implementation phase* the process of fish culture was throughout documented in detailed field notes. In addition to the PAPD, a discontinuance analysis was conducted to identify reasons for success and failure evaluated by the farmers. The following section describes the methods used in each of the three phases.

3.3.2.1 Scoping phase

The first phase of field research constituted a "situational analysis" in order to characterise the relevance of aquatic resources in seasonal floodplains to rural livelihoods. It was implemented between November 2006 and February 2007. Here information about communities, the natural resource systems, and the level of interaction between communities and resource systems was acquired to understand the biophysical, economic, social and cultural environment in the research sites. A range of qualitative and quantitative Participatory Rural Appraisal (PRA) techniques has been applied including community profiles, participatory resource mapping, field observation and semi-structured key informant as well as focus group interviews. PRA is "[…] a family of approaches and methods to enable local people to share, enhance and analyse their knowledge of life and conditions,

to plan and to act" (Chambers 1994, 953).[114] It is a means for outsiders to gather insights from local people and enables the researcher to learn from the villagers themselves, understand their concerns and priorities. However, PRA is primarily intended to enable local people to conduct their own analysis, plan and take action (Chambers 1994, 958; IFAD 2001, 58). One main advantage of PRA is that it makes information clearly visible to everybody for the information to be checked, discussed again and to be revised as well as it enables the research to get an easy access to the community and its members (IFAD 2001, 58). PRA methods include mapping and modelling, observations, seasonal calendars, trends and change analysis and many more. The tools used were adapted to the context and skills of participants and complemented by informal interviews. The field staff in Cambodia and Vietnam was trained in conducting PRA by the researcher herself and pre-tests in other (project) communities were conducted in order to demonstrate the tools, give the field staff an opportunity to practice the implementation and to adjust the tools. One member of the PRA field staff also functioned as translator during the different sessions.

In a first step, data about the HH in the village were collected. A **household list** for each village was developed, representing every HH in the village.[115] Information collected in this list were the name, sex and marital status of the HH head (HHH) in Khmer and Latin letters, whether the HH possesses a trap pond or fish culture pond and whether one or more HH members are engaged in small-scale seasonal commercial fishing (non-subsistence).[116] Further, the list entails information about whether the HH can be categorised as a functional landless HH.[117] Later, the "poverty status" according to the wealth ranking was added. Additionally, another column shows the code used in the survey and thus identifies the HH interviewed.[118] Composing the list took one to two days depending on the size of the community. In a group discussion at least ten villagers were asked to name **indicators of poverty** in their village ("how and why do you know that somebody is poor?"). These indicators were noted down and a classification of these indicators was made for the categories "better-off", "middle" and "poor" (e.g. how much hectare of agricultural land does a HH possess if he is better-off). People

[114] Rapid Rural Appraisal emerged in research and development cooperation in the 1970s and was further developed. With a greater focus on the participatory component, PRA then developed in the later 1980s (Chambers 1994).
[115] A *HH* was defined as an economic entity, which usually holds families ties, lives under one roof and runs the same HH budget. Thus, there was the possibility to find more than one HH living in a single house, when those are having separated HH books.
[116] *Trap ponds* are defined as "dug-out in lower portion of rice fields or areas adjacent to perennial water bodies […]; commonly used to trap aquatic animals when water from the ricefields recede […]"(Morales and Little 2007, 606). *Culture ponds* can be defined as "conventional aquaculture system", that are used to stock hatchery produced seed (Morales and Little 2007, 606). However, in this research, culture ponds also includes ponds that are also used to hold collected aquatic animals harvested from wild stocks. MORALES AND LITTLE define those, however as HH ponds (see also Morales and Little 2007). Fish in culture ponds, in comparison to trap ponds, is often fed by the HH with e.g. kitchen waste.
[117] *Functional landlessness* is defined by the researcher as "not being able to feed the family even in a good year". Thus, although having crop land does not imply that the size of his land is large enough and has the respective quality to make a living and thereby to feed the whole family. This categorisation is used to avoid using a specific parcel size (often used for functional landlessness) as this can lead to mis-interpretations.
[118] See Table 18 in Section B in the Appendix for the HH list outline.

discussed the different indicators and thresholds until they came to an agreement. During the group discussions, these indicators were ranked according to what villagers assumed to be the most important indicator for poverty. Afterwards, HH were classified according to the poverty indicators by three key informants (**wealth ranking**).[119] The facilitator named all HHs one after another and the respondent filled the HH number (attached to this name in the HH list) into one of the three categories ("better-off", "middle" and "poor") according to how she considered the well-being of this HH. These three different lists were compared and disagreements between the three respondents discussed in order to come to an agreement between the respondents as well as to clarify (triangulate) indicators that were given beforehand. Notes were taken during these discussions.[120] The objectives of these tools were to understand poverty and the wealth status of the different HHs from the perspective of the villagers themselves. Implementing these two stages of the research took approximately four to five hours.

In a second step, spatial data relating to land and water and their uses was collected. Resource and social maps were developed in villages where there was no such map available already. Otherwise the existing maps were used, extended and discussed again. In group discussions, providing the group members with paper and different colourised pens, the **resource and social maps** were drawn by the villagers themselves. Discussions were encouraged, questions asked and notes taken. The maps include information about the living area/houses including housing qualities, orchard/vegetable/ponds (trap ponds, culture ponds), fields (if possible individual plots), canals/rivers/roads/bridges, school buildings, markets/shops, churches/temples, commune offices, the village chief housing area, health care centres, areas for extra activities (e.g. coffee shop, stadium, restaurant) and everything else the villagers mentioned. Implementing this tool took two to three hours. The maps also facilitated a triangulation of the HH list and additional HHs were added to the list, when necessary. **Transect walks** were also part of this mapping exercise, where the village and natural resource systems were visited together with villagers and questions about e.g. different zones, soils and management practices were posed by the researcher, also facilitating discussions.

In a third step, the set of tools used aimed at gathering time-related data. The **seasonal calendar** was conducted to get an overview about water levels in dry- and wet season and (water-related) activities during the year. The aim was to understand the village life according to the seasons. In some villages, a seasonal calendar was available already and this existing information was used. Also a fish time line was developed to identify reasons for the decline or increase in fish abundance in certain years and to

[119] Most of the time the village chief, the vice chief and a villager were the key informants conducting the wealth categorisation. There was always at least one female respondent.
[120] If a HH was then put into a category, where two of the respondents originally decided on another category, the HH was marked. Also HHs with no 100 percent agreement about the categorisation were marked. The categorisation was added to the HH list and is available under the term "classification".

identify years where natural shocks or other irregular events took place. Notes about the discussion during the development were taken. The development of both tools took one to two hours.

The fourth step focused on **water management** and **institutional issues** in regard to natural resource management. Maps about reservoirs and water resources were created by the villagers, again in group discussions with paper and pens. Here, the technical feasibility of fish culture in certain areas was discussed. However, the main aim was to better understand use patterns of land and water resources in the community. Further, key informant interviews with semi-structured questionnaires were conducted in order to deepen the issues raised in the discussions in regard to resource use patterns.[121] Additionally, semi-structured interviews were conducted with focus groups in the villages covering the following topics: natural resource management, community characteristics and **collective activities**. The interviews during and after the map development also focused on non-community members, government officials and NGO workers, emphasising the relationship of the community to those other groups. This contributed to the stakeholder analysis. The relevant stakeholders were identified during the different discussions, interviews, and drawing exercises including resource users (e.g. owners/users of land, fishers, farmers and other community members), authorities (e.g. customary, traditional, village councils, government) and others with a livelihood stake (e.g. fish breeders, fish traders). The individuals who can affect or are affected by any initiative undertaken by the project and its outcomes needed to be identified as well as the existing patterns of interactions, local institutions and processes upon which to build for project implementation. Their interests, characteristics and perspectives were investigated, including their access to and control of (natural) resources.

3.3.2.2 Participatory planning phase

For the participatory planning phase and for the following implementation phase a case study approach was chosen. Out of the seven villages involved in the scoping phase, four were selected for an in-depth analysis.

Case studies involve an in-depth examination to provide an accurate and complete description of the case (Marczyk et al. 2005, 147). The conclusions are based on much more detailed and comprehensive information than collected with other methods like surveys (Marczyk et al. 2005, 148). The different action research components were developed and introduced in close cooperation with WorldFish, the FiA in Cambodia and the RIA2 members in Vietnam and implemented between March and November 2007.[122] The researcher trained the field staff in implementing the different tools on village level. In each country, a lead facilitator, who also functioned as a translator, was supported by two to four other

[121] Guidelines for the interviews with key informants were provided by IFPRI in form of semi-structured questionnaires.
[122] The NARES staff also implemented the action research in the project communities that were not subject to this research.

research assistants. A close cooperation with aquaculture experts from the FiA and local fisheries offices as well as with NGOs working the communities was promoted during the whole implementation process. The approach followed was intentionally kept flexible and highly adaptive and most of the tools were only implemented as facilitating tools in order to give the communities the most possible freedom to develop their own ideas in regard to the project. Notes were taken during all interviews, discussions and informal talks in order to examine the process of action plan development. The approach was to observe how the communities develop their plans instead of offering a predetermined plan for the project implementation.

This participatory planning phase was characterised through different meetings with different stakeholder groups and plenary sessions in order to secure that all interests are considered and result in a balanced view. In this phase, strategies and possible solutions were discussed. Stakeholders were supposed to formulate and develop a common understanding of their objectives concerning the project and to identify the constraints particularly those related to natural resources and the project implementation. Several field visits with group discussions and informal interviews as well as site observation were conducted. During the field visits the developed resource and water management maps were used to identify suitable culture sites, clarifying property rights and access patterns within the reservoirs. The information gathered was further discussed and triangulated during **group discussions and focus group interviews.** In general, focus groups can be useful for obtaining individual's impressions and concerns about certain issues (Marczyk et al. 2005, 154). The researcher usually asks a set of questions designed to detect collective views about specific topics (Merton and Kendall 1946; Fontana and Frey 2005) and a detailed description about focus group participant's perspectives and experiences is reached. For this research the "design principles for lasting common property institutions" developed by OSTROM (1990) formed a basis for the investigation of resource patterns in the communities (see section 2.3.2). This also included the analysis of embeddedness of the group in a network of institutions with e.g. support from other (higher-level) institutions. **Informal interviews** with village chiefs, women representatives, farmers and fishermen were conducted also during **site observation**. Farmers that culture fish in individual ponds were interviewed in order to get a deeper understanding of technical, but also institutional issues concerning e.g. property rights and marketing options. Further, the suitability of different fish species was discussed. Project participants were identified who were interested in investing financial means as well as time and effort to support the project implementation. In **stakeholder workshops** the project objectives were defined as well as the process discussed concerning project implementation. Further, the development and adoption of community organisations and institutions for fishery and CPR management played a key role (see also Sultana and Thompson 2003). Farmers created **management committees** and defined the objectives and roles of the institutions. Rules were formulated, modes of operation agreed upon and a detailed **action plan** developed.

3.3.2.3 Implementation phase

In the following implementation phase, the role of the researcher was rather the one of an observer and facilitator instead of a "project implementer" in order to investigate the process of institution building with its rule development and organisation effort. Detailed notes were thus taken during the meetings to analyse the different processes including power structures. Due to the fact that research issues were defined by farmers and researchers together and that all sites were at different stages of the implementation phase, no structured plan is provided about the research process. The amount of data collected at the sites also differs. Different measures were taken at different stages always dependent on the site-specific circumstances. **Focus group interviews** with the fish group participants as well as **individual in-depth interviews** with project participants were conducted in this phase in order to elicit collective experiences with the project implementation as well as to analyse the individuals' satisfaction or dissatisfaction with the processes and outcomes. Further, success and monitoring indicators were defined. Culture sites were visited, discussing all kinds of issues that were relevant for the participants at this stage of the project implementation.

3.3.2.4 Discontinuance analysis

During later **field visits**, problems were discussed on group and individual basis. Rule changes in regard to future culture trials were also discussed. The discontinuance analysis conducted during a second visit in 2008 was implemented in three of the sites where farmers decided not to continue the project. The aim was to identify the main reasons for the reluctance to continue. Different views were considered and thus **group interviews** with fish culture groups as well as **in-depth interviews** with some of the project participant's about the reasons for the discontinuance eliciting their personal views about the project were implemented. Also non-participants were interviewed.

3.3.3 Socio-economic survey

HHs from the four case study villages in the Delta were included in the survey, which was conducted in November 2006 in Cambodia and in February 2007 in Vietnam.[123] The survey was developed by WorldFish in close cooperation with the researcher. One supervisor and four to six data collectors in each country (native Khmer and Vietnamese) were hired to conduct the survey in the four villages. All members of the enumeration team were trained in data collection (e.g. communication skills, minimising bias) and the questionnaires were intensively discussed to reduce confusion about the objectives and the specific questions. Training also included practical training off- and on-site during pre-testing.

A stratified random sample consisting of participating and non-participating HHs was used for the survey. The sample frame was always the entire village. After having implemented the wealth ranking, HHs were selected from each of the three wealth categories. In Cambodia, 44 respondents were

[123] The survey is provided in Section B of the Appendix.

selected for the interviews in each of the villages. Due to a smaller group of enumerators and time constraints, the sample size in Vietnam was reduced to 33 in each of the hamlets. In some villages "better-offs" and "middle" HH were grouped together and sampling was then only out of two groups. This was due to the fact that respondents were not able to identify three wealth groups or the numbers of HH in the "better-off" category was too small. Thus, the first stratification was done based on the wealth status of a HHs. Further, a purposive sampling was added with fishers, female headed HHs and landless HHs. In each of the three wealth categories an equal percentage of these three groups were chosen. To summarise, a two factor design was used with wealth as the primary factor (two and three cases respectively) and key stakeholder group as secondary factor. This included people that are dependent on remittance labour, those culturing fish and/or are seasonal fisherman, and those that are functional landless.

The questionnaire was pre-tested off- and on-site. The survey entailed closed choice-format questions as well as open format ones. The closed format questions were easy and quick to fill in, easy to code, record, and enabled an easy analysis of the quantitative data. This also eased the report of results. However, to do justice to more complex issues and to explore possible themes not considered in the closed format questions, open questions were used to receive a comprehensive range of alternative issues where respondents had freedom to address their issues of interest. This also provided the possibilities to learn more about behaviour arising from status and power differentials, to investigate who participates or profits from the project intervention and what limiting factors for a participation in the project were. An interview for collecting the information took approximately two hours.

The survey questionnaire encompasses 13 sections and was used to obtain information about various aspects of the socio-economic circumstances of the HHs. The questionnaire covers the following sections: HH details; HH member details, HH assets and coping strategies; land holdings and farming systems; cropping and inundation characteristics; aquaculture practices; processing and marketing of aquatic products; fish and meat consumption; institutional membership and collective activities; health problems; remittance, savings and credit; shocks and trends; as well as rice-fish preferences.

The detailed analysis of several HHs contributed to an in-depth understanding of several research issues. Those were partly already covered within the action research, however, the survey enabled a quantification of those issues. Additionally, it was of importance to receive a detailed overview about general socio-demographic data of HHs, including size, average age of HH members, years of education, etc. Those were all considered in the regression analysis that aimed at identifying factors that influence the participation in the project. Additionally, information about income generating activities, HHs finances and consumption patterns were collected. While also using this information in the regression analysis it was also important in order to elicit preferences concerning food,

consumption, etc. One of the most important parts of the survey, contributing mainly to reaching the first research objective, was the section about land use and tenure. Here, in-depth information about a larger amount of HHs was collected in order to better understand property rights within the communities. Also flooding patterns were considered as they are influencing the economic activities conducted on the land during the different seasons. This also contributed to the understanding of the impact of different land tenure forms on the adoptability of the project, thus contributed to research objective two. Further, the section covering issues about collective action, the membership in different formal and informal organisations and the contribution to common achievements within the community was essential for reaching the research objectives one, two and three. Thus, the survey conducted within this research forms an essential part in reaching the research objectives and answering the questions posed as it provides broader quantified data as well as it reveals data that could not be selected via action research.

3.4 Ethical considerations

The research procedure included the collection of existing information, synthesis, analysis and exploitation of information without particular sensitive ethical issues. The research was designed in a manner that rather contributed to the empowerment of the poor and marginalised in their personal and communal lives. It is believed that equitable and sustainable institutions can only be established, if people define the structure, rules and sanctions themselves. As the project aimed at including especially the poor, women and other marginalised groups, the action research is a good measure to involve these groups, give them a voice and even to give the more powerful a broad understanding of these group's interests and difficulties. “Equity” is considered through the involvement of all socio-economic strata in the village and not just the “visible” and articulate persons. Sustainability considerations were done justice with the approach as it is believed that sustainability can only be expected when all relevant stakeholders are involved in project planning, institutional improvement or set-up as well as monitoring and conflict resolution.

Many of the methods applied, required substantial periods of fieldwork, thorough record-keeping, and a high degree of self-awareness and ethical management of social relations. A sufficient understanding of the local context to gain access, recognise informal institutions, and accurately interpret culturally coded observations is necessary to implement such a research (Poteete et al. 2010). The researcher herself took these issues into account. The ethical issues were also discussed with enumerators, facilitators and translators as well as with supervisors during the trainings as well as before and after field trips. The selection of the Khmer and Vietnamese staff was done carefully with employing mainly people that come from rural areas themselves, thus being aware of the difficulties people might face. The team always made an effort to be sensitive to community conflicts and to capture these in the analysis.

Questions from participants were always invited and findings from the action research were fed back to the community. People were treated respectfully, no matter of the position they held in the communities. Language was always kept simple, methods were adapted to the local situations (e.g. pictures were used instead of written words), enabling also the illiterate to participate. Further, in regard to gender mainstreaming, women and men without any distinction were involved in the different tools all along the research. Also, the research team always represented a balanced number of men and women.

The incentives for participating in the research were considered as an important factor. For project participants, the incentives were more obvious as they expected an increase in knowledge in regard to the fish culture as well as a monetary output at the end of the culture season. They were aware of the fact that cooperation in regard to research will also be required when participating. The researcher as well as the project staff were always honest and transparent about possible benefits to the community from the project (even whether the project will be implemented in the respective village or not) in order to avoid raising peoples' expectations which may not be fulfilled. It was always avoided to "pay" participants for contributing their time and knowledge. However, recognising their efforts and knowledge as very much valuable (especially as time spent with the researcher reduced their time to make a living), it was always envisaged to create the meetings in a pleasant way, where e.g. lunch was provided to participants. Additionally, small gifts (e.g. sugar or fish sauce) were given to the interviewees of the surveys.

The procedures of the experiments followed the professional practice of these kinds of experiments and the general accepted norms in this research realm. In the introduction of the experiments, players were informed about the objectives, the process, the duration, the way the data will be analysed as well as about potential conflicts of the experiment. After being informed about these issues, the players decided autonomously and voluntarily whether they wanted to participate. They were also told that they can leave the game situation whenever they want. Questions were always possible. Villagers were not forced or "convinced" to participate and a lot of effort was given to explain the experiments in order to ensure that each participant understood the intentions and procedures. Cross-checking and further descriptions (e.g. calculation examples) were used until the participants were sure that they fully understood the procedure and the outcomes.[124] The experiments were conducted in buildings separated from outsiders and the decisions of the participants were kept confidential all the time and also after the games ended. The monetary means to be gained by the participants were adjusted to the local wage rates. It was also considered that the games could trigger conflicts because frustration about free-riding and disappointment in regard to the money earned was to be expected in some cases,

[124] This was especially important in the trust game as it was possible to leave the game with no money at all. In the CPR and PG games the participants always gained at least enough for compensating their time effort (even when Nash was played all the time).

especially as the amount of money that participants were able to earn was not marginal. This can also put people in danger after the outside team has left. In order to prevent conflicts, the training of facilitators as well as the introduction of the games was carefully crafted. Through careful explanation and testing it was ensured that participants understand the potential conflicts of interest. Further, the team stayed in the villages also after the last game played to ensure that participants find a contact person in case of conflict.

Data that was more sensitive (e.g. income or food consumption) was collected in face-to-face and "private" interviews and not in group discussions. Further, it was always ensured that interviewees as well as participants were sure that any information given or decision taken will be treated confidentially. Survey data was also kept confidential and no names are published in connection to the data. Potentially embarrassing and threatening information was deleted and it is ensured that no sensitive personal data is published. These issues are especially important as the participants will not be able to read the findings themselves. By supplementing the evidence from the experimental design with data from field observations and survey methods the evidence for the hypotheses are strengthened and a more ethical design results.

3.5 Summary

This chapter provided information about the research paradigm, the methodology used as well as a detailed description of the methods applied. One section was devoted to ethical issues that were considered during the research.

As a research paradigm methodological pragmatism was applied in order to do justice to the complexity of the institutional issues addressed. Mixed methods were used to answer different research questions at different stages of the research. In the mixed method approach the consolidation of data gained from different findings improves the understanding of the research issue in light of different angles including the different fundamental assumptions of both (post-)positivism and constructivism. The mix of methods also contributed to a triangulation as data gained through different sources complement each other. Contradicting data from different methodological approaches focused the researcher during the process to these issues, forcing a more throughout analysis and the collection of additional data.

Action research was conducted in three phases, including a deeper analysis of institutional issues in four case study communities. The action research methods are not structured and in-depth in contrast to the standardised questionnaires used in the surveys, which were implemented in four communities with 33 to 44 HHs in each community. The experiments form another important part of this investigation and follow the general accepted research procedure, but were adapted to local conditions.

The research was conducted in a sensitive way and the researcher considered the relevant ethical issues during field visits and research implementation as well as during the design of the research, training of the field staff as well as during the analysis of the data.

After introducing the particular subjects and hypotheses that were investigated, the following section four provides the descriptive data collected via action research. The qualitative action research data were analysed using *Atlas.ti 6.1* software, also comparing the materials developed at the different sites (e.g. maps and seasonal calendars). Section five presents the data gathered with the survey. This section contributes to deepen the understanding of issues investigated with the action research and gives further insights for answering the research questions. Based on these findings, hypotheses were developed and tested with the experiments. Those will be presented in section six. The empirical data collected with the survey and the experiments was analysed by using the statistical software *Stata 10.0*.

4 Analysis of action research data

4.1 Introduction

The action research mainly captures the exogenous variables defined in the IAD (see section 2.3.1). The following data thus focuses on the *attributes of the communities* with its social structures and socio-economic characteristics, the *biophysical conditions* of the communities as well as the *rules* in place in regard to water and land management, collective action and project implementation. The results also mirror the diversity of each of the case study sites. The analysis of the data supports answering the research questions in regard to the adoptability of a community-based approach in the region and the underlying institutional arrangements that influence this adoptability. In a first step, understanding of the respective situation in the field was necessary (research objective one). Additionally, the impacts of the different identified formal and informal institutions on project implementation (research objective two) as well as the interactions of the different stakeholders in regard to the project were investigated (research objective three).

The following section is structured as follows: section 4.2 provides findings from the scoping phase. In this phase, the main emphasis was on gaining data about the local specificities in each of the sites, including HH lists, poverty indicators and seasonal activities. Additionally, formal and informal institutions in regard to the management of natural resources in each of the communities were investigated and will be described. The second and third section then provide findings from the planning and implementation phase, investigating also the development of rules and the use of those. Further, cooperation during the implementation is evaluated with a description of conflicts that occurred. The fifth section presents an evaluation of the project done with participatory tools and focus group interviews. Reasons for discontinuance mentioned by the farmers are listed here. The last section summarises the findings.

4.2 Scoping phase with situational analysis

In the scoping phase, the main objective was to identify the village characteristics that enable the researcher to increase her understanding for the diverse institutional arrangements in place in each of the communities. Thus, it was important to gain knowledge about main village characteristics like the size of the villages, poverty indicators and the distribution of poverty, resource characteristics, fishing activities and other income-generating activities. Further, a main objective was to identify informal institutions that govern the water and land use as well as the access to fishing and aquaculture grounds. This all contributes to reaching the research objective of understanding underlying institutional arrangements and their dynamics (research objective 1).

4.2.1 HH list

The size of the villages and hamlets was considered to be an important characteristic as cooperation in smaller groups is often higher than in larger groups. Further, the amount of female (widowed) headed HHs, the amount of trap pond and culture pond owners and the percent of landless and seasonal fishermen were identified as distinguishing features that help understanding the specific constitution of the villages. Table 4 shows the total number of HHs in the two Cambodian (PE & TK) and the two Vietnamese (TPB & E2) research sites. The Cambodian communities are all smaller than the Vietnamese hamlets with TK being the smallest one with 96 HHs and E2 in Vietnam being more than four times larger (445 HHs). The amount of female headed HHs lies between 15 and 73 percent and is visibly very high in E2 hamlet. The third column in Table 4 shows the percentage of widowed HHH within the female headed HHs.

		Number of HHs in village	female headed HH in % within village	widowed female headed HHs in % within female headed HHs
Cambodia	PE	133	22.6	96.7
	TK	96	31.3	60.0
Vietnam	TPB	243	15.3	70.3
	E2	445	73.0	7.7
	Total	**917**	**46.1**	**23.2**

Table 4: Amount of HHs, percent of female headed HHs and percent of female HHH widowed

Table 5 indicates the possession of trap and culture ponds and whether a HH is landless and/or engaged in seasonal fishing. A total of 3.2 percent of HHs (n=917) are having trap ponds, all being Cambodian. The amount of HHs possessing a culture pond is more equally distributed among the four villages and constitutes 12.3 percent in total (Table 5).[125] The third column in Table 5 shows the percent of HHs that are functional landless. Striking is the high rate of 81.3 percent of functional landless in TK. Also in sum, the amount of functional landless is much higher in the Cambodian villages than in the two Vietnamese villages. Overall, 16 percent of all HHs are engaging in small-scale seasonal commercial fishing activities, indicating that at least one HH members sells part of the fish catch at markets, to middlemen or within the village.

[125] In TK, the amount of culture pond owners is highest with almost 18 percent, which is due to a CARE Cambodia initiative that supported HHs in the development of ponds and provided fingerlings for the fish culture in the year 2006 (pers. communication CARE Cambodia 2006).

		% of HHs with trap pond within village	% of HHs with culture pond within village	% of HHs that are functional landless	% of HHs in seasonal commercial fishing
Cambodia	PE	1.5	14.3	14.3	63.9
	TK	28.1	17.7	81.3	25.0
Vietnam	TPB	0	9.1	5,8	9.5
	E2	0	12.4	3.4	3.4
	Total	**3.2**	**12.3**	**13.7**	**16.0**

Table 5: HHs possessing ponds, engaging in small-scale seasonal commercial fishing and landless HHs

4.2.2 Poverty indicators and wealth ranking

As the project aimed at addressing specifically the poor members of the communities it was important to gain an understanding about poverty in the villages. The aim was not to rely only on secondary income statistics as poverty is often attributed to manifold indicators not being considered in these statistics. Thus, the local knowledge about poverty was used in order to characterise and categorise HHs among different poverty categories. In all communities, poverty indicators were developed by the villagers themselves in a participatory session. In total, seven **poverty indicators** were identified by the Cambodians villagers.[126] The following three indicators were, however, named in both villages: *Land*, *Housing quality* and *Livestock ownership*.[127] In regard to different poverty categories (poor, middle, better-off) having, for example, zero to 1 ha of agricultural *Land* characterises a HH as being poor. A HH in the middle category has 0.5 to three ha.[128]

In Vietnam, the tool was implemented in the same manner; however, farmers in all villages only mentioned two indicators: *Income* and *Land cultivation*. In both villages, the indicator *Land* was ranked as most important.[129] The specification of the different poverty categories is also very much concrete and similar in both hamlets. Someone having less than 0.5 ha of land is categorised as poor. In E2, 0.5 to three ha is used for the middle category and more than three ha for the better-off category.[130] Looking at the *Income*, having less than 18.75 US$ per month per person is used for the poor category in E2 (less than 12.5 US$ in TPB). Someone having more than 50 US$ in E2 (31.25 US$ in TPB) per month per person is categorised as better-off.

[126] In PE, no ranking of poverty indicators was made as the indicators were developed by the villagers in an exercise implemented by the Chamroe Chiet Khmer Organisation (CCK). This list was used, although it did not entail a ranking exercise as well as only two poverty categories (middle and poor).
[127] Additionally, the following indicators were identified by the villagers in PE: *Assets*, *Occupation/Education* and *Family size* and in TK: *Diseases*, *Transportation*, *Droughts* and *Debts*. The Table 19- Table 22 in the Appendix show the poverty indicators for each of the villages.
[128] In regard to *Housing quality* the kind of building material plays a more distinguishing role in comparison to the size of the housing area.
[129] The farmers did not mention more than these two indicators, which correlate with the government used indicators (pers. comments of facilitators and farmers). When asked to add their own views about poverty, they confirmed that this is how they distinguish different wealth status.
[130] In TPB it is less with 0.5 to 1.5 ha for the middle category and above for the better-off category.

Figure 5 shows the categorisation of HHs into three categories "better-off", "middle" and "poor" in each of the four villages. This categorisation is based on the respective poverty indicators the villagers developed themselves.[131] In all villages the HHs in the "poor" category exceed the ones in the "better-off" category. In TK, the amount of poor HHs even exceeds both the "better-off" and the "middle" HHs. The percentage of female headed HHs in the three categories is not significantly different from the male headed HHs. Female HHs are represented in all poverty categories (Pearson's chi^2: r = 0.4370; p<0.804)[132]. Also female headed widowed HHs are represented in all poverty categories (Pearson's chi^2: r = 0.6376; p<0.727). Thus, being a female (widowed) headed HHs does not increase the possibility to be rather poor and these HHs are equally represented in all three poverty groups.

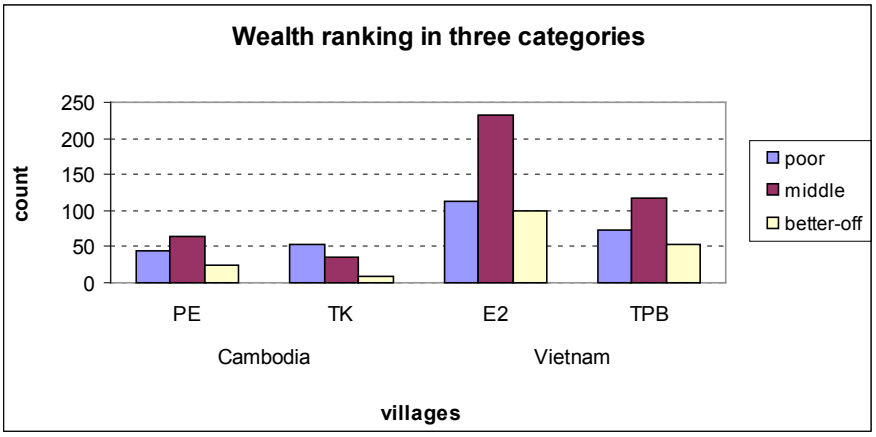

Figure 5: Wealth ranking of HHs in four villages in three categories

However, when cross tabulating the trap pond owners with the poverty categories, one can see that they are rather represented in the middle (55.2 percent) and poor category (31 percent) than in the better-off category (13.8 percent). Culture pond owners are rather represented in the middle (46.9 percent) and better-off category (38.1 percent). Only 15.4 percent of the HHs categorised as poor possess a culture pond. Seasonal fishermen are represented in all three categories with 42.2 percent in the poor, 40.1 percent in the middle, but only 17.7 percent in the better-off category. However, looking at the cross tabulation of wealth categories and the HHs that are functional landless it becomes obvious that almost three quarters of all functional landless are categorised as poor (74.6 percent). Only 23.8 percent of the landless are categorised in the middle and 1.6 percent in the better-off category. Figure 6 gives an overview about the amount of pond owners, seasonal fishermen and landless HHs in the three poverty categories.

[131] Only, in 12.4 percent of HHs the key informants disagreed in their categorisation. However, after discussions between the three key informants, those HHs were categorised in one of the wealth categories, but were marked in order to exclude those from the survey sampling.

[132] The Pearson's Chi^2 test is used as a measure of the strength of the linear dependence of the two interval scaled variables. The correlation coefficient ranges from -1 to +1 with a value of 1 implying a perfect linear equation relationship between the two variables. The p-value indicates the significance of the correlation coefficient.

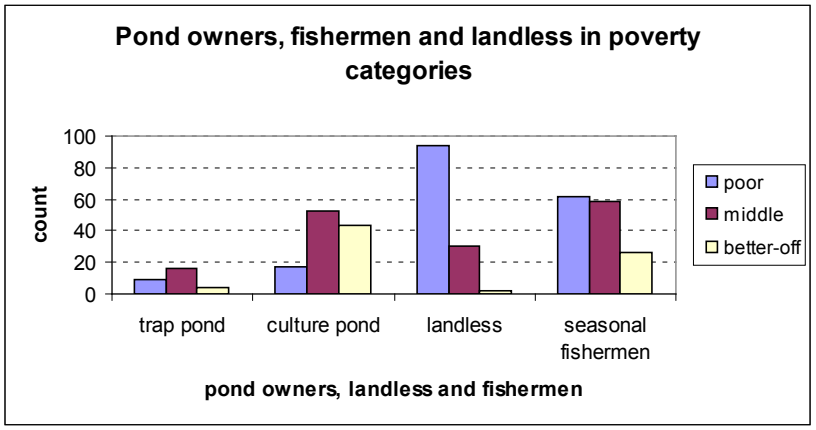

Figure 6: Pond owners, seasonal fishermen and landless HHs in three poverty categories

4.2.3 Resource maps

The resource maps developed give an overview about the four village and their characteristics. These as well as the Google satellite maps (Figure 53 - Figure 60 in the Appendix) show that the Cambodian villages are both located at the boundaries of reservoirs, whereby the Vietnamese villages are based next to larger distribution canals. In all villages, extensive areas of rain-fed paddy lands with less dense settlement extend beyond the village centres. The canals indicated in the resource maps provide water to those rice fields and lead water further to other villages. Houses in all villages mostly build a strip settlement along the streets, canals and dikes. In Cambodia, many houses are built on stilts in order to prevent flooding during wet season. Houses in the two Vietnamese hamlets are in general of higher quality than houses in the Cambodian villages.

Figure 7: Khmer house on stilts in TK (left) and Vietnamese house in E2 (right)

The Cambodian villages do not possess tarred roads and are rather difficult to access, especially in rainy season when the roads get destroyed by rain and floods. TK is the most remote village, located 16 km from the nearest service centre (Mesang) and 40 km from the nearest accessible surfaced (national) road. PE is about seven km away from the next tarred road and the next economic centre. For villagers in Vietnam, economic centres are easily accessible by tarred road in a distance of not more than five km. However, TPB must be accessed by boat from an opposite lying village when coming from the closest economic centre (Thoi Lai).[133]

[133] The resource maps also indicate pagodas, temples and churches, the houses of village chiefs, small shops, schools and public areas. None of the villages possess a community centre and village meetings are normally held at a villager's house, school buildings and the church (E2). In regard to the water resources, wells, trap and

4.2.4 Seasonal calendars

All agricultural activities in the research villages are determined by the season, which in turn also influences non-agricultural activities (e.g. celebrations are often after the harvest season). Activities mentioned by the villagers in all four villages were: *Rice cropping*, *Livestock rising*, *Fishing*, *Fish culture*, *Fruits and vegetable (cash) cropping*, *Remittance labour* and *Celebrations*.[134] The two most important activities were rice cropping and fishing.[135] These will be explained in the following in more detail as they are also considered to influence the project implementation substantially as both activities interrelate with the fish culture in terms of competitive resource use. Further, the respective time schedules also influence the time farmers will have available to engage in the project activities.

Rice cropping

The main income generating activity in all four villages is rice farming, which is highly dependent on flood patterns. In Cambodia, the rainy season is from May till October and the dry season from November/December till May. Farmers in Cambodia are thus engaged in rice cultivation between May and February/March, depending on the time and intensity of the flooding. In dry season, many of the villagers are not able to cultivate their land because of a lack of water for irrigation. The most labour intensives periods are July till August (field preparation), September (transplanting) and January till February (harvest). In the Vietnamese villages, the flood season starts in August/September with the peak flood reached in October. In November, the flood recedes and farmers start the preparation of fields for the next rice crop. The harvest of cultured fish needs to correspond with the flood patterns and thus the time for fish culture within the project is predetermined. In the Vietnamese villages, most farmers are able to realise three crops from November till February, the second from Mid-February till May and the third from June till September as water can be pumped into the rice fields for irrigation in dry season. During the rest of the year gravity serves water into the field. The rice culture in the region is following a calendar dictated by the DARD of Can Tho City, implemented by District and Commune Officer and the Farmer Associate representatives at hamlet level (see also Joffre 2008). This influences the aquaculture activities planned within the project as fish must be harvested with the release of waters from the reservoirs. Thus, the culture period in Vietnam is predetermined due to the DARD regulations.

---

culture ponds, bridges, sluices, culverts and drainage pipes are also indicated in most of the maps as well as rice mills/throwers. In general, it can be stated that the Vietnamese villages are in general better-off or further developed in terms of infrastructure than the Cambodian villages.

[134] Further in at least one of the villages, *Handicraft production* and *Sugar palm production* were mentioned as well as *Lotus planting* and *Shop keeping*. Figure 61- Figure 63 in the Appendix provide the seasonal calendar for three villages. In TK, the information gathered by CARE International were used instead of developing an additional seasonal calendar.

[135] In both countries, cropping of vegetables is done throughout the whole year, with most labour input during flood season. Crops planted are bananas, potatoes, beans and corn, cabbage, beans and morning glory. Livestock raising (ducks, chicken, cows/buffalo, and pigs) is also conducted during the whole year requiring an equal amount of labour input in every month. Migration to larger economic centres for remittance labour is done throughout the whole year. Mostly men also engage in short-term labour migration between the labour intensive transplanting and harvesting seasons. The jobs conducted include construction work, motor dup driving, garment and harvest labourer.

Fishing, Fish abundance and Fish culture

Fishing efforts for wild fish concentrate not only on wet season, but are mainly undertaken from September till November, when flood is highest and fish abundant. Farmers fish in rivers, canals, reservoirs and small ponds using all types of fishing gears (e.g. nets, hooks, traps). In PE, it is reported that there is enough fish available for the village and that there is no fear of undersupply in the next years.[136] In TK, villagers report an increase of fish in the reservoir, as new sluices built in 2006 prevent fish migrating southwards.[137] However, the villagers also report that individual catches decrease as more people use the reservoir for fishing these days with an increase in small-scale commercial fishing activities. Further, a decrease in fish abundance is also associated to the use of "modern and larger" as well as of illegal fishing gears (e.g. fine mesh nets or electric fishing). In the Vietnamese hamlets a decrease in wild fish is reported in the last ten years as well, although in TPB it is said to still be sufficient fish for the villagers.[138] In E2, fishing for wild fish is considered to be something that landless and poor HHs do and people that are wealthy enough buy wild fish at the market. However, it is reported that the fish in the community is hardly enough even for the landless and poor. Reasons for reduced catches are seen in an increase in human population and thus in active fishermen and the use of larger and illegal fishing gears. Further, it is aligned to the newly built structures and the mitigation of natural spawning and refugee areas. As a reaction to the decline in wild fish, people started to culture fish themselves many years ago, they explain. Here, the most labour input is between June/August (stocking) and October/November (harvest). However, the pond preparation at the beginning of the culture season (April/May) also requires a larger labour input.[139]

To summarise, the culture of fish within the project can be seen as an important source of fish supply at least in the villages where fish is not abundant. However, in most of the villages, the fish culture is rather seen as contribution to income generation with the aim to market the fish after the harvest instead of contributing to the HH food security. Nevertheless, landless and poor HHs seem to face a shortage of access to fish and thus the project might be a way to contribute to higher food security.

The data presented in this section showed the diversity of natural and socio-economic characteristics under which the project was implemented in the different communities. It was shown that poor HHs are rather not involved in aquaculture, but they mainly engage in seasonal commercial fishing activities. Poor HHs are also often functional landless, which corresponds to the poverty indicators, where *land* was named as one of the main distinguishing features for poverty in all four villages. The season and thus the water levels influence most of the income generating activities. In addition to rainfall patterns, the timeframe for rice cropping in Vietnam is further dictated by the government. In all villages, fishing is an important part of HHs activities and contributes very much to HHs

[136] CCK also started a pond culture presentation project in PE, using plastic tanks for frog, fish and eel culture.
[137] Further, CARE Cambodia released 20,000 fingerlings into the reservoir in 2006 and an additional 20,000 fishes were released by the Cambodian government during the National Fish Day 2006.
[138] In contrast, JOFFRE (2008) founds farmers reporting a decrease in fish with a drop of 70 percent since 2003.
[139] This fish culture is done on an individual basis, where farmers dig ponds on their homestead.

consumption, at least for the poor. Several reasons for a decline in fish abundance were named, but an increase in fishermen and the use of larger as well as illegal fishing gears were mentioned in all villages.

4.2.5 Local natural resource management

Assessing the local (formal and informal) land and water management patterns was one main objective of the research presented in this dissertation. It contributes to answering the research objective one and it determines the action that can be taken within the project framework. Besides the formal analysis presented in section 1.1, the local analysis presented here contributes to understand who gets access to what kind of resource at what times of the year. These are important indicators not only for identifying the project's stakeholder, but also for explaining the adoptability of the community-based approach.

All villages are closely connected to larger waterbodies that are used for multiple purposes and by multiple user groups. The adjacent water resources play an important role providing water for irrigation of paddies and thus are an integral part of their livelihoods. Furthermore, the water resources are used for fishing as well as for many other HH activities, including soaking animals, watering gardens, transport, washing, waste disposal and drinking water. In all villages (except E2), the water resources are also used for all sanitary purposes. In Vietnam, the canals also play a key role for trading (floating vendors).

Figure 8: Different water uses in TPB hamlet- pond toilet, floating market, cooking and fishing

Table 23 in the Appendix gives an overview about the villages' main waterbodies.[140] PE village has access to the Tunloub reservoir (2,197 ha), which is part of a larger system of a total of four reservoirs north of the village. The reservoir encloses a total of 19,410 ha. On the eastern side, it is bordering the national road No.2, which separates the paddy fields lying west of the road from the direct use of the reservoir. The reservoir was built during the Khmer Rouge regime and is fed through rain waters and the Mekong River. In sum, 21 villages from six communes and two districts use the water from Tunloub reservoir. Boeng Khei reservoir (TK village) has a size of about 750 ha. It is fed by rain waters and the Bassac River. Also here, a Khmer Rouge era dike encompasses the original naturally floodplain lake. In 2006, the dike was extensively renovated and two new sluices were incorporated by CARE Cambodia (pers. comment CARE Cambodia 2006). In total, 2,394 HHs from 18 villages and six different communes use the reservoir (FWUC 2004, Article 30 & 31).

[140] See also the Google maps provided in section C of the Appendix.

In Vietnam, both villages are based within the Long Xuyen Quadrangle and the distribution canals serve water to smaller channels that are connected with the paddy fields. Individual sluice gates (e.g. up to 100 in E2) serve water to the different paddy fields for irrigation. The amount of users of the water resources cannot be estimated as many different communes use the larger canals. However, the flooded rice fields are mainly accessed by HHs from neighbouring communes and the villagers themselves.

Local land rights and water use rights

Section 1.1 provided an overview about the legal framework for the use of land, water and fisheries in both countries. However, on local levels the governance of natural resources is influenced by additional rules and/or traditional rights. In each of the communities it was expected to find another institutional framework governing the resources and thus also influencing the project implementation. Understanding the property rights and rules was thus an important step. Data about the local framework was collected with different participatory tools and semi-structured interviews. Here, the findings from the local level analysis will be presented. Table 6 summarises the main features of land and water governance identified in the four communities. A more detailed description follows.

Village	Land rights	Water management	Comments
PE	Officially granted private ownership rights HHs own 4-5 plots	No village level water user committee FWUC, Water Resource Office and commune head decide about sluice operation 7 downstream user villages	Cadastral survey 2006 Land prices are stable Land transfer requires registration & fee
TK	Temporary use rights to land inside the reservoir, Land outside the reservoir de facto private property, no official registration until now	FWUC (more than 770 HHs) FWUG established by CARE: monitoring and maintenance of the dike 11 downstream user villages	High land fragmentation
TPB and E2	Private use rights (considered as private property) No boundary conflicts	No water scarcity Individual access to water during dry season Region wide regulation for water release	Low land fragmentation

Table 6: Overview land and water governance

In June 2006, a cadastral survey was undertaken in PE and it is one of the first villages in Cambodia that were able to register official private land titles.[141] In the course of registering, every family received 250 m^2 of land plus the land they had informal use rights to prior to 2001. PE villagers report that although some boundary conflicts occurred, every villager is now holding the officially granted private land title to his paddies and homesteads. Villagers report that land transfers decreased since the registration and that prices for land are very much stable at 150 US$/ha. However, land transfer is reported to be more complex now with registering the new property holder in the cadastral survey (see also Royal Government of Cambodia (RGC) 2001b, Article 65), including a fee of 200 US$. HHs now own four to five plots on average. PE is represented in the FWUC of Prey Ampok commune, which was established in 2004 (FWUC 2004). Regarding water governance on village level, there is yet no official representation of water users. However, villagers in PE report that they plan to establish a FWUG in their village. The reservoir in PE is part of a complex irrigation system and water flows are controlled by different institutions. There are five sluices and one culvert used for regulation water flow in and out of the reservoir for the purposes of irrigation. Four of the five sluices are opened and closed through the FWUC and the Water Resource Office on district level, whereby the fifth one is operated by the village head with decisions about when to open and close it are taken by the commune head. The bridge culvert is, however, operated by the commune head.

Villagers in TK use agricultural land mostly inside but also outside the reservoir. The seasonally flooded land in the reservoir is government owned, but villagers hold temporary use rights of the land.[142] Villagers are aware of the fact that those paddies can be claimed back by the government at any time, they report. Agricultural land outside the reservoir is private property, however, without being officially registered under the LMAP so far. The levels of land fragmentations are much higher in TK with for example 1.5 ha divided to up to ten plots. In regard to water management, the FWUC in Svay Chrum commune represents approximately 770 HH including the villagers of TK. CARE Cambodia also established a FWUG led by the village head with the six Krom leaders as members.[143] This FWUG was established in the course of renovation and building efforts CARE Cambodia undertook in 2006 and is now responsible for monitoring and maintenance of dikes and sluices. Besides the villages that use the reservoir for fishing, there are at least 11 downstream user villages that use the Boeng Khei reservoir for irrigation. Three sluices lead water into channels and then to the respective rice fields. TK is responsible for the operation of two of the sluices, the neighbouring commune for the third one. Villagers in the catchment area address their water needs for irrigation to

[141] These parcels are certified by the MLMUPC and the provincial/municipal governor under the Article 13 and 14 of the Sub decree 46 and Article 30 of the Land Law.

[142] People in TK are not possessors of the land in the reservoir as they do not have the rights to exchange, transfer or sell the land. They use "State Public Property" that is not eligible to be subject to possessions. However, the state can grant rights to occupy or use the land that are temporary, precarious and revocable (RGC 2001b, Article 16). Only in the case that state public property is transferred to state private property, farmers could also apply for ownership (RGC 2001b).

[143] This officially by-law established FWUG is recognised on commune level (FWUC 2004).

the FWUC; the FWUC then informs the responsible village chief to operate the sluices according to the order.

In Vietnam, farmers in both hamlets hold certificates of their land use rights and explain that the land is "private property" that can be transferred through the willing-buyer-willing-seller principle. Conflicts about paddy boundaries are not reported in any of the villages. Further, land fragmentation is rather low with mostly one and occasionally up to three plots per HHs. Although the land law states that each HHs' land for agriculture or aquaculture shall be no more than three hectares (SRV 2004, Article 70 (1)) several farmers own more than these three ha. Water flow to paddies is regulated on an individual basis with no conflicts reported. The water resources hold water during the whole year and water scarcities are not reported by the farmers. During dry season, people access and cultivate their paddies on an individual basis.[144] As mentioned, there is one region-wide regulation concerning the time of water release, where the DARD announces a certain time frame in which the water in fields needs to be pumped out in order to prevent the spread of insects in the region. Usually, everyone follows this regulation as in the case of non-compliance villagers would fear a lack of governmental support in the future, they report.

Fishing rights and aquaculture regulations

Access to water resources is legally not restricted in any of the villages (see also section 1.1). Further, seasonally, there are no restrictions for family fishing, which is allowed during the whole year in any of the public waterbodies. However, in all villages the Cambodian and Vietnamese national fishing laws apply. Both law restrict the use of fishing gears and e.g. forbids the use of fine mesh nets (e.g. mosquito nets), long trap nets and electric fishing gears.[145]

Villagers explain that monitoring of fishing practices and the sanctioning of offenders is in the responsibility of the police and the community fisheries office/inspector and that they are requested to report the use of illegal fishing gears to these authorities whenever observed. In fact, the monitoring lacks effectiveness due to several reasons and illegal fishing practices can be easily observed at local levels, especially at night. The village chiefs and villagers themselves report that they know which members of the community use illegal fishing gears. However, reporting the offenders to the authorities is not common and as it is mainly poor people using illegal practices and thus there is a kind of understanding and tolerance towards this group.[146] However, a high level of frustration is reported in TK village due to the ineffectiveness in preventing illegal fishing activities.[147] Besides

[144] Farmers that own plots close to dikes and channels use private sluices to irrigate their plots, whereby "landlocked" farmers with no direct access to the channels use small earthen dikes and culverts to control the water flow into their paddies.
[145] Rules concerning fishing in both countries are spread via TV, radio and mouth-to-mouth.
[146] Villagers in PE also report that they fear revenge of offenders when reporting them to the authorities.
[147] The village chief in TK, for example, reports that 18 people in his village are using illegal fishing gears, regularly and that he knows precisely who those are. However, sanctioning mechanisms are not in place.

monitoring of the fishing activities, the police officers are also responsible for any other crime, their observation and persecution.[148] Offenders in regard to illegal fishing practices are rather seldom caught in Cambodia especially as they can easily escape when being approached by the police. However, if caught, the illegal fishing gears are confiscated; fines are seldom imposed.[149] Instead, the offender must sign an agreement of not using illegal gears in future anymore. When further offences occur, fines increase, but higher jurisdictions are not very often called for.

In addition to the illegal fishing regulations, different formal and informal agreements were made at least in one reservoir concerning a restriction of the fishing area. In Boeng Khei reservoir (TK village), a fish sanctuary was established in cooperation with CARE Cambodia. Here, fishermen as well as authorities at province, district and commune level agreed on a fishing restriction in this area.[150] Further, some villagers installed "illegal" trap ponds within the reservoir years ago and now hold *de facto* private use rights to these areas. These areas are also recognised as non-fishing areas by the community and pond owners are allowed to request compensation for fish being caught in these areas by anyone other than themselves. Additionally, one farmer owns a culture pond that is integrated in the reservoir. The same informal agreement applies as for the trap pond owners.[151] The use of illegal fishing gears seems to be less in the Vietnamese case study sites. However, in flood season, illegal practices are more common and offenders are apprehended about once per week. Offenders must hand over their fishing gears and police officers can impose a fine. The village leader and the party leader also have the right to confiscate gears and fine the people. Also here, villagers are aware of the people applying illegal fishing practices, however, reluctant to report those. It is explained, that offenders are often poor people and thus it is tolerated.

To conclude, the analysis of natural resource management revealed that property rights on land, water and fisheries in both countries are interwoven due to the seasonal changes. In Cambodia, the registration of private property is under way and people in one of the villages already hold private ownership rights to their paddies. On the other hand, water management is rather unregulated in the Cambodian villages. Communication between the water users happens informally and sluice gates are opened upon request by village heads. Monitoring and sanctioning of offenders that e.g. use illegal fishing gears are ineffective. Further, co-ordination between different communities in regard to the water resources is restricted. The water management functions of the FWUC are still weak and there is limited coordination at reservoir level. WUGs are not established or not functioning yet. In Vietnam,

[148] The police officer responsible for TK reports that the area to be monitored is too large for patrolling and that he cannot secure a 24hrs control.

[149] Which might be due to the fact that by law the police officer is not in charge of investigating illegal fishing practices (see RGC 2001a, Article 82).

[150] The TK village chief monitors the fishing activities in the sanctuary (which is opposite of his house) and reports that there are people still fishing in the sanctuary, also here especially at night.

[151] Also villagers in PE report that they had a fishing restriction due to a fish sanctuary and breeding ground in the reservoir. The regulation, however, is not in place anymore. The villagers explain that the Fisheries Officer was responsible to secure that there is no fishing in the respective area but that there is de facto no monitoring and thus the rule is also de facto not in use anymore.

long-term use rights to land are granted to the people, who see, however, their property as "private". Due to the highly developed canal systems, water for irrigation can be used according to the individual decisions of the farmers, requiring less dependence on coordination. The implementation of aquaculture activities is only possible with the permission of the MoF and according to the "masterplan".

4.2.6 Collective activities

During the action research, a first analysis of collective activities was conducted, too. The objective was to gain an overview about already existing collective initiatives in the communities that might be valuable to be considered as entry points for the project implementation. Further, the amount of collective initiatives already in place were considered as an indicator for cooperation within the villages in general. This short presentation of collective activities within the communities shows that although there are already existing structures in place, the activities of these groups are diverse and often rather limited.

In PE, CCK supported the formation of three different self-help groups. These are a group for 1) the prevention of a brown plant hopper outbreak with 30 members; 2) a saving group as well as 3) a bicycle group, in which people share bicycles for transportation. In contrast, CARE Cambodia reports a low level of collective engagements in TK and thus fosters community-based activities within the village, including the establishment of rice and credit banks as well as the FWUG. People in TK explain that they used to work together, but that "now the market rules the game and there is no time anymore to help each other" (pers. comment village chief TK). Therefore, they rather hire labour instead of supporting each other in e.g. the harvest season. Cooperation also rather occurs between relatives.

The following official groups are institutionalised in every Vietnamese commune and branches of each are found on the hamlet level: Farmer and Woman Organisation, Youth & Veteran Union as well as a Health Care Organisation.[152] All groups have their own written membership and rules. However, the levels of activities of these groups are very much diverse within the hamlet as well as across hamlets. Some of these groups are rather only formally established and *de facto* not functioning.[153]

The data presented in the section above was collected during the scoping phase in order to gain information about the different communities with their natural resource systems. It was considered as essential to acquire an understanding of the biophysical, economic, social and cultural environment in each of the research sites in order to ensure that project planning and implementations takes site-specifics into account. In the following section the participatory planning within the villages will be described.

[152] The Farmer Association is a volunteer organisation to exchange experience on techniques. The Woman Union aims at improving women's knowledge and fosters equality for women. The Veteran Association aims at the reduction racial discrimination. These organisations all belong to the Vietnam Fatherland Front representing the umbrella organisation of registered mass organisations and interest groups (Thayer 2008).

[153] Further, the catholic community plays an important role for farmers in E2 hamlet. Regular services and many additional events are organised by the commune members and the church.

4.3 Participatory planning

In the participatory planning phase, the research objective was to accompany the planning and preparation of the project and thus to get an understanding about how groups were formed, formal and informal rules crafted and how respective enforcement mechanisms were established. The following section thus describes the inception, group formation, rule establishment as well as the preparation works.

4.3.1 Inception in Cambodia[154]

After the PRA was completed in the four communities and the technical possibilities for fish culture in the available water resources were confirmed, the FiA organised Inception workshops in Takeo (PE) and Prey Veng province (TK) in July 2007 (Figure 9).[155] The respective village chiefs, four villagers, NGO representatives as well as communal and provincial authorities participated in the meetings. The aim of the workshops was to introduce the project's main objectives to the villagers and authorities, to explain technical options for the fish culture in the respective water resources as well as to discuss institutional options for project implementation and management (see also Pich and Heng 2007).

The workshop was organised in different sessions, including the following:

- presentations and discussions about:
    - former experiences of WorldFish in CBFC;
    - main purposes of the project;
    - technical options for the fish culture and available resources in the villages;
    - support from FiA (material, training).
- group discussions about:[156]
    - the possibilities of fish culture in the villages (location, material, training needs);
    - process of group formation and participation in the project;
    - issues of monitoring, sanctioning and conflict resolution;
    - benefit sharing arrangements.

[154] The Inception workshops in Vietnam were organised before this research was conducted and thus there is no primary data available on these. However, village chiefs and villagers did not participate in the inception workshops held in Ho Chi Minh City. The research team at RIA2 selected suitable fish culture sites together with local authorities during site visits. The District Economic Officers of the respective districts attended the meetings and then suggested the project to the villagers in E2 and TPB in 2006 (see also Werthmann et al. 2007).
[155] These workshops were a joint effort of the FiA, WF and the researcher. In each of the workshops there was a second community invited where the project was also implemented, namely Chrey Poan (Takeo Province) and Potamoum (Prey Veng Province).
[156] The villagers from each of the village formed a group. The second group included the local authorities with the Commune Chief, Commune Council, the Provincial Fisheries Office Head and the Director of the District Department of Agriculture.

Figure 9: Participants (left) and group work (right) during Inception workshop in July 2007 (Prey Veng)

Main workshop results

Participants from both villages expressed their interest in participating in the project. Both villages also identified suitable sites for fencing and fish culture. Material for fencing purposes and fish feed were mentioned to be available in both villages, but additional materials (e.g. vine, poles and labour) were requested to be provided by one of the supporting institutions. Both groups explain that they need training in fish culture techniques, monitoring and report writing. In regard to the group formation process, the "authorities groups" stated that villagers must be willing to contribute their local properties, the culture area and fencing material.

Further mechanisms were suggested by the "authority groups":

- Establishment of a community regulation and an official government by-law to avoid disputes;
- Establishment of a clear hierarchy of responsibilities in regard to conflict resolution mechanism with involvement of the village chief, the Commune Council and other local authorities (e.g. local police), the FiA and the authorities on district and provincial level;
- Sanctioning mechanisms (two time advice and punishment in case of non-compliance).

Both groups further presented their findings on how benefits are supposed to be shared within the community. Table 24 in the Appendix gives an overview about the shares attributed to the different groups by the "villagers" and the "authorities" as well as the final agreement reached. While the shares distributed to the involved stakeholders differ, the figures show that also poor community members as well as the community as a whole were considered as stakeholders that are supposed to profit from the community-based project.

4.3.2 Group formation, membership and rules

After the Inception workshops, village level meetings were arranged by the FiA in cooperation with the respective villages and commune chiefs. In these meetings, work plans were established, indicating the time for the different tasks that need to be fulfilled before the fish can be cultured. Responsibilities for each of the assignments were written down. Also, sites for the fish culture were chosen. While in PE village no difficulties with the group building process were reported, the group building in TK must be described as rather slow. The group members later explained, illegal fishing activities in the

area are common and they assume that people did not want to join the group as they are heavily involved in illegal fishing (see also Heng and Pich 2008a). Reasons for the reluctance are also assumed to be a fear that the workload associated with the project will become overwhelming, also due to the fact that people were already involved in other initiatives enhanced by CARE Cambodia which also included a fish culture project on private homesteads. Additionally, young people migrate for remittance labour and were thus not available to join the group (see also Heng and Pich 2008c).

In Vietnam, RIA2 staff in collaboration with the commune chiefs chose culture sites where the approach was considered as technically feasible. In TPB, the DARD took the initiative and contacted the village. The village chief and other community members then approached different people in the village to participate. In E2, the commune officer presented the project to village members and chose a site in cooperation with villagers (Werthmann et al. 2007). In both hamlets, the possibility to participate in the project was dependent on the culture site as only members holding land within the respective area were eligible to participate. Farmers that had land in the area, but did not want or were not able to participate in the projects left their land to the group.[157] Table 7 gives an overview about the amount of members in each group, the size of the culture sites, the technical approach as well as the financial contributions made by them.

Village	Amount of members in culture group	Size of culture area	Technical approach	Individuals' financial contribution to project
PE	17	2.5 ha	Fencing of land in the public reservoir	2.5 USD
TK	7	0.6 ha	Fencing of land in the public reservoir	3 USD
E2	28	120 ha	Enclosure of "private" rice fields	31.25 USD/ha owned in the respective area
TPB	28	39 ha	Enclosure of "private" rice fields	12.5 USD/ha owned in the respective area

Table 7: Overview about fish culture groups, sites, technical approach and contributions[158]

It becomes obvious from the description as well as the figures that the planning and implementation of the project in these four communities differs substantially. Also the technical approach varies between the countries. In the Cambodian villages, the project must be seen as a small-scale initiative of smaller groups, whereby in Vietnam large areas were enclosed with membership in the groups only being possible for farmers that were able to make an investment of 12 US$ or 30 US$ respectively and that

[157] Three people have land in the area in TPB, but did not participate in the project. In E2, 24 people own land within the project area, but were not part of the project. However, three of those 24 landowners initially wanted to participate, but were, due to financial restrictions, not able to.

[158] In TK, there were initially seven persons in the group. One member passed away in a moto accident before project implementation. A second one, a member of the commune council, moved away during project implementation, so that there are actually only five group members remaining.

possess land within the chosen culture site. In E2, where financial contributions are highest, the local authorities established links to a local bank and promised that the bank will provide loans to farmers who are willing to participate but lack the financial means to do so.

Overall, female participants are underrepresented in all of fish culture groups with TK and TPB not having female members and PE and E2 only having two female members.[159] Forty percent of the HHs participating in the fish culture belong to the "middle" poverty category, 27 percent to the "better-off" and only ten percent to the "poor" category.[160] Overall three landless HHs are members in the project, all of them living in TK (the village with the highest amount of landless). Only in E2, the members are all "ordinary" villagers. In all other villages, the village chiefs or village vice chiefs were part of the project. In TK, the group was finally composed of (former) Krom leaders and the village chief, which are all part of the CARE Cambodia support group, too.[161] Thus, although the project aimed at being inclusive and to mainly support poor HHs, the composition of the groups shows that it is mainly the middle and better-off as well as official representatives of the villages participating in the project. Based on these findings, the question on the beneficiaries of the project needed to be explored in more depth. The socio-economic survey analysis presented in section five contributes to getting a deeper understanding on what determined project membership.

Management board and regulations

All group elected a management board (by open majority vote) with a leader, a vice leader and a secretary. In Vietnam, both groups also had a strict book keeping system and an accountant in charge. The voluntary involvement in the committee works was not compensated financially. In terms of benefits all groups decided to equally share those between the members. All groups had written membership records, but no written rules or regulations. However, members in all groups were able to recount several rules. One important rule established in all of the four groups is the restriction of fishing in the project area (see also Figure 10). This restriction affected the whole community, including not only the project farmers and farmers that have rented out their parcels to the fish culture group, but also all other community and non-community members. All groups further established a 24hrs rotational guarding system for the fish culture sites, explaining that otherwise fish would be stolen by non-group members from both within the community and from outside. However, none of the villages established sanctions in case of non-compliance with this rule. In all villages (except in TK)[162], small huts were established on site, where group members were hosted during the night to

[159] Although there were also female headed HHs in the group, it is only men working together, which is considered as common. Male as well as female villagers explain that women usually are not involved in these kinds of activities and that they care for other duties of the HHs. Women also attended meetings and covered for their husbands, when those are busy.
[160] In E2, no single "poor" HH is participating in the group.
[161] As an explanation, the group members report that they felt they are responsible to demonstrate the feasibility of the project to the other villagers and that is why they agreed to the project.
[162] In TK, the culture site was visible from the village chief's daughter's house.

fulfil their guarding duties.[163] Nearly all members of the group in E2 attended two free training courses in rice-fish culture at the Economic Extension Office (district level). There was no training in the other villages.[164]

Figure 10: Sign indicating the culture site/denied access in TPB village

To summarise, different technical approaches were used in the two countries. While the Cambodian villages focus on small-scale initiatives with only fencing-up small areas within the reservoir, the Vietnamese villages established larger projects with increasing the height of dikes. In Vietnam, the process of identifying suitable culture sites was dominated by technical considerations, which also determined the possibility to become part of the project. Additionally, villagers who wanted to participate, but were not able to pay the initial contributions were excluded from the project, when the bank denied access to a loan. The land of these farmers was, however, used in the project and the owners' choices regarding the use of their own land were reduced due to the project. One main rule that all CBFC groups shared is the one of exclusion of others from the fish culture site. Being aware that the investments must be protected, guarding systems were established in all of the sites. However, in none of the villages, formal sanctioning systems were developed. Also the by-laws and community regulations were not established, although mentioned to be important during the inception.

4.3.3 Preparation works

In Vietnam as well as in Cambodia, farmers needed to prepare the culture sites prior to the stocking of fingerlings (see for example Figure 11). This process was reviewed and supported by the respective implementing institutes (FiA in Cambodia, RIA2 in Vietnam). Further, the composition of fingerlings to be stocked was discussed by the farmers and the aquaculture specialists. Fingerlings were then ordered.

[163] Two additional rules were mentioned by the group in TPB. The labour input during the harvest was tied to the size of the land with one working day per ha owned in the culture site. Further, there was an agreement on the selling price: the fish group agreed on not selling fish below the agreed price.
[164] According to the Vietnamese Fisheries Law (2003), aquaculture producers have the right to receive training on aquaculture practices (see section 1.1.3).

Figure 11: Culture site fence in PE (left) and bamboo collection in TK (right)

In the two Cambodian villages, nets were used to enclose the culture sites. Villagers were therefore responsible for collecting (or buying) bamboo sticks to be used as poles. In TK and PE, every participant had to contribute labour for collecting bamboo sticks and an amount of 2.5 and three US$ respectively for additional fencing material. Further, the FiA contributed nets and ropes to both of the villages worth 105 US$. Preparation works in TK was delayed and not implemented when planned. Farmers explained that this is due to the fact that they also want to postpone the time of stocking until there are no animals fed in the reservoir anymore as these are assumed to interfere with the fish culture. Further, members explained that they are still busy with other duties. However, the FiA as well as CARE Cambodia report a disappointment in working with the community as farmers seem to have promised to fulfil certain duties within project context, but then often did not (Heng 2007).

In TPB, dikes in the sufficient height were already available, but were improved by the members in order to prepare them for the project. Difficulties during the preparation works were not reported. In E2, a dike that was already in place was heightened for the project with an excavator hired for this purpose. This heightening of the dike caused several externalities. First of all, some of the farmers having land bordering the dike lost part of their parcels as the dike is now expanding into their paddies. Compensation for this loss of land was neither intended nor provided to those farmers. Additionally, the small private sluices incorporated in the old dike were destroyed for the purposes of the project. Further, land was rented from the church as the new dike absorbs more space outside of the respective area as well.

4.4 Project implementation

4.4.1 Fish culture, harvest and marketing

Table 8 gives an overview about the time of fish stocking and harvest as well as the total amount of fish stocked and harvested in the four culture sites. In Cambodia, the first trial of fish culture started in November 2007. Fish culture at the project sites in Vietnam began in July and August 2006 (see also Figure 12). The fish grow-out period was four to five months in Vietnam, and two months in Cambodia.

Village	Time of fish stocking	Time of harvest	Amount of fish stocked in kg	Amount of fish harvested in kg
PE	Nov 2007	Jan 2008	≈ 178 kg (10.5kg/ha)	≈ 25 kg (1kg/ha)
TK	Nov 2007	Jan 2008	≈ 105 kg (15kg/ha)	0 kg
E2	Aug 2006	Nov. /Dec. 2006	≈ 750 kg[165] (6.25kg/ha)	11,288 kg (403 kg/ha)
TPB	July 2006	Nov. 2006	155 kg (4 kg/ha)	7,700 kg (197.4 kg/ha)

Table 8: Time of stocking and harvest, kg stocked and harvested

The amount of fish cultured lied between 10.5 kg per ha in PE and 15 kg per ha in TK (Heng and Pich 2008c).[166] In both sites, it was decided to pump out water in the culture sites in January to harvest the remaining fish as it was assumed that, due to several reasons, the amount of fish left in the ponds is rather low. This was confirmed and in both Cambodian sites the harvests was low with 25 kg in PE and zero kg in TK.[167]

Figure 12: Stocking of fish in TPB hamlet in 2007 (pictures by Huynh Huu Ngai)

The situation was very much different in Vietnam. In TPB, 155 kg of fish were stocked in July and the harvest in November 2006 yielded 7,700 kg. Fish was sold to middlemen.[168] In E2, fish was introduced in August and harvested at the end of November and at the beginning of December 2006 with a yield of nearly 11,300 kg. Small amounts of the harvest were sold to neighbours, but most of it was sold to wholesalers.[169]

When looking at the stocking rate per ha, the most efficient culture trial can be found in E2 where 400 kg per ha were harvested. Overall, most inefficient in these terms is the TK culture site with zero kg harvested although 105 kg were stocked. Reasons for the differences in the yield are diverse and will be described in the following section.

[165] This figure is based on own calculations, based on the weight of fish and the amount of money spent on fingerlings. All other figures in this table were provided by farmers and/or the research institutes.
[166] In PE and TK, species introduced were tilapia, silver barb and Indian carp.
[167] Farmers in TK only harvested 10 -15 kg (non-stocked) predators (mainly snakehead).
[168] The farmers here were also able to buy fish from the project themselves, but for the same price as middlemen.
[169] In both hamlets, the main species stocked were common carp, bighead carp and silver barb.

4.4.2 Financial outcomes of the projects

This section presents detailed figures about the investments, the costs as well as the income generated with the marketing of fish in each of the sites (Table 9). Overall, the profits realised are low or even negative when looking at net profits.

Item	PE	TK	E2	TPB
Area (ha)	2.5	0.6	120.0	39.0
Members (#)	17	7	28	28
Contribution per member (US$)	2.5	3.0	155.8	14.2
Contribution per ha (US$)			36.4	10.2
Investment				
Support by project (US$)	1186.4	655.1		
Support from other organisations (US$)			1437.5	
Conribution of culture group members (US$)	42.5	21.0	4362.4	396.9
Total investment	**1228.9**	**676.1**	**5799.9**	**396.9**
Costs (US$)				
Dike construction or fencing material	105.1	105.1	3697.6	93.8
Fingerlings (including transport and material)	1081.3	550.0	1980.9	414.4
Harvest (including transport and material)			1350.5	
Hut construction			79.7	
Labour guarding			812.8	396.9
Land and pond rent			1046.9	
Administration			18.8	
Other			384.1	
Total Cost	**1186.4**	**655.1**	**9371.2**	**905.0**
Total Cost per hectare	**474.5**	**1091.9**	**78.1**	**23.2**
Income (US$)				
Income from fish marketing	0.0	0.0	7673.3	1600.0
Total Income	**0.0**	**0.0**	**7673.3**	**1600.0**
Total return (Total Income ─ Cost)	-1186.4	-655.1	-1697.9	695.0
Total return (Total profit ─ Cost)/ha	-474.5	-1091.9	-14.1	17.8
Total return (Total profit ─ Cost)/member	-69.8	-93.6	-60.6	24.8
Actual profit/loss per member	-2.5	-3.0	118.2	24.8

Table 9: Financial statement indicating overall investments, costs and profits for four villages in US$[170]

Villagers in PE and TK did not harvest enough fish for selling and both villages used the harvest to organise a festive dinner for the group members. The total income is thus zero US$ in both villages.[171] The FiA supported both projects financially and contributed more than 1,000 US$ to the culture group in PE and 655 US$ to the group in TK.[172] For both projects also the overall return is negative. Farmers lost their initial investments of 2.5 and three US$ respectively, which correspond to one to two daily

[170] Future benefits of investments are not considered as they are impossible to estimate. Also, even worse might be future costs of the overall investments that are also not considered in the table presented above.
[171] Farmers in PE shared the fish that they harvested within the group. Everyone who participated in the harvest (10 members) received three to four fish each. The remaining seven members decided not to help as they assumed that the benefit will be not worth the effort.
[172] The differences are due to the amount spent for fingerlings, which is twice as high in PE as in TK because of more kg stocked in PE.

incomes. No costs for labour contributions are listed here as group members voluntarily covered all activities themselves.

The farmers in TPB are the only ones who were able to realise a positive return. Compared to the overall costs of 905 US$, the farmers realised a positive income of 25 US$ per member, without the financial support from other institutions.[173] In E2, nearly 2,000 US$ were spent for the fingerlings, which is also due to the high amount of kg stocked. However, the highest amount (over 3,000 US$) was spent for the dike construction. Farmers themselves contributed over 4,000 US$ to the project and the PC supported the project with 1,437.5 US$. Due to this additional investment by the PC, the members also made a profit of 188 US$ on average.[174] However, without this funding, 9,000 US$ of costs oppose only 7,600 US$ of profit. Thus, also in E2, a negative overall return of -1,697 US$ must be mentioned. High costs are also associated with the renting of land from the church (345 US$/year) and renting land for storing the fish before marketing (692 US$). The following sections will give reasons for the differences and the actual negative returns in three of the four villages.

4.4.3 Natural incidents and technical difficulties

Several difficulties were reported during project implementation. Those included natural incidents and technical difficulties. However, also poaching and conflicts within the groups and with other community members were mentioned. The following section will present more detailed information on the reasons that led to a small harvest and disappointment within the fish culture groups.

Three groups reported difficulties during project implementation related to natural incidents and technical problems. The most important ones are mentioned in the following: In PE, the farmers lost fish during a natural occurring flood that came unexpected late in the year. Due to heavy rains, the flood level in the reservoir and thus in the culture site raised as high that fish was able to escape over the nets. In January, they decided together with FiA, to pump out the water to check how much fish was left. Only three to four fish per member were harvested and immediately shared. In TK, flood patterns were good. However, when the culture site was prepared prior to stocking, the group emptied the site from all wild fish to prevent predators to be left in the culture site (see also Heng and Pich 2008b). Not all predators were caught and those left ate all fingerlings stocked. Thus, at the end, they harvested four to five large predators, that presumably have eaten all the cultured fish. In E2, one major incident was that the newly built dike broke during a storm. While trying to fix the broken parts, some of the cultured fish escaped. New heavy investments were required to repair it.[175]

[173] Farmers in TPB did also not hire labourers and fulfilled all work duties themselves. The 397 US$ spend for labourers were actually paid to the project farmers themselves for guarding duties.
[174] Profits were actually shared according to ha owned in the culture area and not per member.
[175] The group members as well as the commune office later contributed money to fix the dike.

The project implementation and success was thus heavily influenced by natural patterns like flooding and weather conditions as well as on technical difficulties. However, besides these incidents, also conflicts within the groups as well as with the wider community were reported to be at least partly the reason for project failure. The following section explains how project members themselves evaluated the conflicts that occurred in the wider community. The section 4.4.5 then focuses on the conflicts that occurred within the fish culture groups themselves.

4.4.4 Poaching and other conflicts with non-members

As planned, in all sites the fish was guarded 24hrs a day during the whole culture season. In Cambodia, the group members themselves took the duty in a rotation system. In TPB, farmers used the initial investments of the group to pay themselves a loan for the guarding. In E2, however, either labour was hired within the hamlet for guarding the culture site or farmers themselves took care of it, but then also were compensated for each shift. Thus, being aware of the possibility that others will try to steal fish from the culture sites, all groups established monitoring systems.

In the Cambodian villages poaching was reported to basically not happening. In PE, there were also no other conflicts reported.[176] In contrast, group members in TK report severe conflicts with non-project members. The group complained about:

- High water turbidity around the culture site, which affected the fish, caused by: [177]
    - watering livestock by non-project members close to the site
    - fishing in the CARE Cambodia Sanctuary, where water is deepest and thus wild fish abundant (see also Heng and Pich 2008c).[178]
- Destruction or lifting of the site's net on purpose by non-project members while fishing there. This caused a high frustration as group members say they know who is to be blamed and that these are the same people that usually use illegal fishing gears. It is again mentioned, that the fight of illegal fishing activities is their main problem.
- The commune council, commune head and the police were addressed to solve the problem, no solution was found.[179]

Following incidents were reported by the Vietnamese farmers:

- Non-project community members did not give up their fishing efforts in the project site. Also farmers that hold land inside the project area, but did not participate in the project, did not give up their fishing efforts and even increased it in some cases.

[176] It is explained that the community supports the idea of fish culture and that everyone is curious to see the results in order to later learn from the project and try fish culture themselves.
[177] Some species cannot cope with this high turbidity as their gills get clocked and the amount of oxygen they absorb is thereby critically reduced.
[178] The CARE Sanctuary, where the project site is located as well, is the deepest area within the reservoir. Thus, there is still a high abundance of fish even when water in the rest of the reservoir recedes.
[179] However, the FiA explains that they might also not be willing to solve the conflict as it occurred before a national election and they were afraid of losing the votes (Heng 2007).

- The commune officer was asked for support in conflict resolution, but a solution was not found. It was only proposed to include these farmers into the project in the next year (E2).
- Due to the continued fishing in the culture site by non-members, also group members themselves started to fish in the culture site again. Overall, a substantial part was fished away before the official culture seasons ended.
- In TPB, group members agreed that taking own fishing gears to the guarding shift and to harvest some of the cultured fish for their HH consumption is allowed. Thus, most of the fish that was harvested before the official group harvest was presumably taken by group members.

4.4.5 Collective activities, group conflicts and free-riding

Besides financial means, contributed by all members without exception, there were other duties group members had to fulfil. These included meetings, but also dike or net construction and associated activities, stocking of fingerlings, harvest of fish (including pumping activities in Vietnam) and marketing efforts. In all villages, only small conflicts between the members are reported and group members explain that these were usually solved informally through explanations, discussions and encouragement.

However, in individual interviews farmers of all groups reported some difficulties within the group. The main points are summarised as follows:

- In TK, all five farmers explain that due to the disappointment caused by the loss of fish and conflicts with non-group members they "lost their spiritual strength". Due to this, labour contributions to the project decreased.[180]
- In PE, free-riding in regard to guarding was very much lower than in TK and only reported to have happened occasionally. However, also here some group members said, that they lost their "motivation and spiritual group strength", when they realised that a large portion of the fish escaped.
- In TPB, free-riding in regard to guarding duties was reported to happen regularly. People on shift left sooner than agreed on, making this possible.[181]
- In E2, a high level of frustration is reported, because of heavy free-riding within the group. There was not only a low attendance in the meetings, but also participation in collective work activities was described as very much unsatisfactory. Further, when the dike was damaged by the storm the financial contributions to fix it were rather low.

[180] Every one of the five members only fulfilled his guarding duties once or twice. Afterwards, the leader was left with the guarding responsibility on his own, with the argument that the culture site is visible from his daughter's house and that he should spend the nights in here house in order to guard the site.

[181] This was, however, not considered to be a major problem that is not easily solved by informal discussions. Offenders were convinced that guarding is necessary to protect the investments made. However, TPB is the only group that established a sanctioning system for not fulfilling one's duty. A fee of 2.5 US$ was to be paid, which was then used for buying drinks for the groups' meetings.

4.4.6 Linkages to other institutions

Also linkages to other (high-level) institutions were considered to be relevant in the project context as they can provide support to local institutions and increase the acknowledgement of the local collective initiatives. However, in both Cambodian villages there were no further linkages to other organisations, wholesalers or hatcheries established. One main complaint from the farmers in TK is the missing support from local authorities. When they were faced with the destruction of their nets by other community members, they called the commune council and asked him for support (e.g. to call the police). Although, the group asked for help even several times, they were left alone with the conflicts, they report.

The Farmer Organisation in E2 hamlet fostered a link between the culture group and a local bank that promised to give project members a credit so that they can participate in the project. The idea was that the lack of capital should not limit the participation. However, the chance to access credit was felt to be unfair and not all people were able to access a credit (they e.g. had one already, or were too old or sick to obtain a credit). In TPB, farmers also explained that they were lacking financial support, because some members had difficulties to pay their share of investments and had to borrow money from other project farmers to be able to participate. Furthermore, farmers reported that they lack technical support in the form of training, information or learning networks. The leader hoped that the commune officer would have taken more responsibility. He also thinks that the guarding of the fish would actually be the responsibility of the government. Farmers further explained that they are interested in establishing common distribution channels with other aquaculture groups in order to have a stronger bargaining position, but did not feel able to establish such a network themselves.

To summarise the findings from the implementation phase, the evaluation of the financial outcomes has shown that three villages had a negative overall return, whereby the investments made were lost. Natural incidents (unusual high flood and a broken dike) are explained to be the reasons that led to a decrease in the fish yield in two of the sites (PE & E2); remaining predators in the waters, and thus a technical problem, is the reason for no yield in TK. In TPB, the only village with a positive return, no major natural or technical incidents were reported. Challenging were also conflicts with non-group members as well as with members that continued fishing in (or close to) the sites. The monitoring of the fishing sites did not prevent a loss of fish. This is due to the size of the culture areas that cannot be easily patrolled, especially at night. Further, concerns were raised by several farmers if persons on duty were actually guarding the fish. Finally, severe conflicts arose within the group in E2 due to the dike construction/repair.

4.5 Project evaluation by farmers and discontinuance analysis

After the first trial of fish culture, three villages (PE and TK in Cambodia as well as TPB in Vietnam) decided to continue with the project in the following culture season. In E2, the group decided not to continue. Based on the outcomes, a discontinuance analysis was implemented in E2 to identify specific reasons for the reluctance to continue the project. The following section aims at presenting the adjustments in project implementation that were made by the groups as well as the reasons for discontinuance in E2.

4.5.1 Project evaluation by farmers in Cambodia

Thirteen group members in PE decided to start a second trial.[182] In TK, four of the five group members explained, that they want to continue with the project.[183]

Several positive associations with the project were mentioned by members in Cambodia. One main belief of the farmers is that profit can and will be generated when the technical problems are overcome. Also, in both villages, farmers explained that they feel that the project is a good capacity building measure and that they have learnt a lot in regard to fish culture. They are satisfied and will share their new knowledge with the rest of the community. Farmers in PE found further positive criteria and mention that they were satisfied with the collective work and the acceptance in the community (e.g. no poaching). They also believe that the "project can increase team spirit through the common work and the sharing of experience". Additionally, the fish abundance in the reservoir increased (especially silver barb), which is due to the fact that the cultured fish escaped during the flooding.

Negative associations with the project mainly concern technical problems with late flooding mentioned in PE and remaining predators in the culture area in TK. Further, in both villages some farmers indicated that the solidarity in the group decreased due to the disappointing developments during the first trial and that individual fish culture might be easier to organise as there would be no coordination efforts with decisions taken on an individual basis. Also, technical problems would be reduced when doing the fish culture on an individual basis. Some farmers expressed the suspicion that other community members did actually fish in the sites and stole fish. They said, this was partly only possible because some members did not fulfil their guarding duties. There is also doubt that the project is technically feasible as "flooding is irregular and very difficult to predict".

[182] Four members resigned from the project after the first trial, whereby one of them (the former group leader) moved away. However, three new members joined the group for the second trial. In individual interviews, two of the members that left the culture group explained that they still believe that the idea is good, but they have other, not further specified, reasons for leaving the project.
[183] Only one member decided to leave the group and he did so already during the first trial.

In PE, the group members suggested two main adjustments. First, stocking should be done in another site, which lies higher and is smaller with only 0.5 ha. It is also closer to the village so that guarding becomes easier. Second, the nets used must be of higher quality to prevent holes through which the fish can escape. In TK village, the group members wanted to build a dike within the reservoir in order to prevent outsiders to interfere with the project. Also, it then would be easier to empty the area of predators and reduce turbidity in the water, they explained.

Overall it must be mentioned that the groups were motivated to invest money and time in a second trial. They were interested in increasing their knowledge concerning aquaculture and strongly believed the project can be beneficial to the community. However, in both following years, 2008 and 2009, the water levels in the reservoirs did again not permit the fish culture to proceed.

4.5.2 Project evaluation by farmers in Vietnam

The whole group in TPB hamlet decided to continue with the fish culture.[184] In E2, half of the group decided not to continue with the project and accordingly the whole project was terminated.

In TPB, positive associations with the project mentioned were the financial profitability of the project and the high learning effect in regard to fish culture. The training received was considered as very helpful. Adjustments made by farmers in TPB include 1) the heightening of the dike in order to prevent fish escaping during heavy rains; and 2) the establishment of a better cooperation with middlemen offering higher prices.[185] Also, due to the initiative of RIA2, the rules were adjusted and written down. Following changes of rules were made:

- The management committee must not take guarding duties anymore, only "ordinary members";
- It is now forbidden to carry fishing gears/ fish in the site during guarding duties; and
- Sanctioning for not fulfilling duties is formally institutionalised.[186]

In E2, reasons for discontinuance were elaborated.[187] Farmers mentioned that one of the main reasons for not being interested in starting a second trail is that profits in the first year were so low. Also, the work in the group was not satisfactory, there was mistrust and conflicts in the group, a "bad atmosphere" and "reduced solidarity". Group-members also explain that poaching by and conflicts with other community members were a hindrance. Some members also accused other group members

[184] Membership in the group did not change as well as management positions did not.
[185] During the first trail, they tried to sell the fish themselves at the market, but this led to most fish being rotten before it was sold and thus profit further decreased.
[186] It is stated in the new regulations that "[…] any member who catches fish without the agreement of the cooperative will be punished by local authorities. If any subgroup will not finish her duties will be punished 10 percent profit after harvest. In case of serious damage, the subgroups organise a meeting to make an agreement for compensation" (written regulations of culture group in TPB 2007).
[187] When asked about a concluding statement, most interviewed project members described the fish culture project as "a complete waste of time".

for poaching, explaining that those few spoiled the project for everyone. Especially when comparing the profit to the labour input, members complained about the high labour input they faced during project implementation. Women explained that they did not like the fact that they were alone during night while their husbands were guarding. Further, the fact that not everyone received a credit was felt to be unfair by members as well as non-members. One of the main negative impacts many farmers raised was the dike construction, which reduced the land size of the adjacent fields, destroyed sluices and reduced the water flow in the area.[188] These negative impacts also expand in the future.[189] Most farmers also complained that they were denied access to their "own" rice fields for fishing and other, e.g. agricultural practices (e.g. preparation of fields for next crop).[190] Finally, group members expressed that they lacked support from the authorities. Actually, they felt betrayed as the "authorities pushed them, then when problems arose did not help". Alternatives to the project evaluated by farmers in E2 were to either culture fish individually to avoid conflicts and reduce coordination efforts or to simply rent out the land to duck owners, which promises a fair return with no labour input at all.

Summarising, three of the four case study groups decided that they would like to continue the project. Reasons for the dissatisfaction are site-specific, but include not only difficulties in regard to the technical implementation, but also conflicts within the groups and/or the communities. Further, although promised, the implementing agencies and local authorities were expected to support the groups in case of conflict occurrence. However, two of the four groups report that they did not receive support when they faced conflicts. Only one village (TPB) actually did continue with the project in the following year, but decided to discontinue after this second trial, too. This group, however, realised that rules will need to be adjusted to increase profits (e.g. no fishing is allowed for group members anymore and sanctioning was institutionalised). Although planned, both Cambodian villages were, due to flow patterns, not able to culture fish in the following year.

4.6 Summary action research

The section presented gave detailed insights into the project preparation and implementation. Further, outcomes of the projects in each of the sites were presented with also identifying reasons for low monetary outcomes. Additionally, during group and individual interviews, difficulties in regard to conflicts and free-riding, poaching and support from other institutions were mentioned. This last section now summarises the findings according to the research objectives.

[188] One member e.g. reported that he lost 1x6 m due to the dike expanding into his parcel.
[189] The land for the dike was partly rented from the church and this rent will need to be paid in future as well. A solution how to finance the rent was not proposed. Further, farmers that lost private sluices needed to rebuild those and lost additional financial means.
[190] In an individual interview, one of the excluded land owners explained that he did not get a loan because he already had a loan and because he suffers from a sickness. Due to the project, he was not allowed to plough his rice fields after the last rice crop. This reduced his rice crop to 6.5/tons per ha in comparison to 7.5 tons in the year before. Another group member also explained that his main loss was that he was not allowed to fish in the site anymore. Before the project trail, they were able to catch fish for their daily consumption from the area, but now they cannot access wild fish anymore and must fish in other areas further away.

The analysis of the village characteristics and their natural resource management gave insights into the existing **institutional arrangements** for water, fishing and land access. It became obvious, that these institutional arrangements are subject to interwoven dynamics and that access rights change with the seasons. All communities have different rules for access. Nevertheless, main features that are shared in all communities include the open access to water during the rainy season. It became also obvious, that while formal institutions to prevent the use of illegal fishing are in place, the enforcement characteristics of those are not functioning.

In a second step, it was shown that these institutional arrangements **impact** on the project implementation. The open access situation with missing de facto sanctioning mechanisms led to the fact that fishing continued in the project sites and that investments made by the project members could not be protected against poaching. Also within the project framework, formal sanctioning mechanisms were not introduced, although monitoring was considered as important. It is questionable whether a formal sanctioning would have been possible, considering that the water resources are PGs that can be used by every community member for every purpose. Nevertheless, even when local authorities would have established formal sanctioning mechanisms, the legitimacy of those would need to be questions as the project would then have created an exclusive situation, where some community members would have been excluded to benefit from the project. It can be concluded that the underlying institutional arrangements play a significant role for project implementation.

The **interactions** between the relevant stakeholders and the impact on the adoptability of a collectively managed semi-intensive rice-fish aquaculture production technology were analysed within this section as well. It became obvious that in none of the villages “full cooperation” was reached and free-riding and poaching occurred. This is true for the project groups, but also in respect to the wider community. In order to further investigate the relationship between the underlying institutions and the cooperation between the stakeholders, experiments were conducted and will be presented in section six. First, however, in the following section five findings from the socio-economic survey will be presented.

5 Empirical findings from the socio-economic analysis

5.1 Introduction

The following section five presents the analysis of the data collected via the more formalised questionnaires. Overall, 160 surveys were conducted. The analysis will contribute to quantifying the issues addressed within the action research and will thereby provide a better understanding of the issues addressed within this research. Nevertheless, also research issues not covered with the action research will be presented.

Table 10 gives an overview about the numbers of HHs interviewed in each of the four villages, the percentages of HHs interviewed in regard to the total number of HHs in the village as well as the amount of project farmers included in the survey. Accordingly, the survey covered at least 28 percent of all project farmers in each of the villages.

Village	Numbers of HHs interviewed	% of HHs interviewed in regard to whole village	Number of project farmers interviewed	% of HHs interviewed in regard to all project farmers
PE	44	33.1	5	29.4
TK	44	45.8	3	60
TPB	36	14.8	11	39.3
E2	36	8.0	8	28.6
Total	160	17.4	27	33.8

Table 10: Interviewees in survey and the percentages covered in each village

Beside the data about 160 HHs, the survey also included the collection of information about HH members and thus contains socio-demographic data of a total of 924 HHs members. Interview respondents were HHH in 53.1 percent, the wife/husband of the head in 36.9 percent and the son/daughter in 7.5 percent of the interviews.[191]

The following subsections present the analysis in seven parts. The first section covers the analysis of the socio-demographic data collected about HH members, including age, education and occupation. The second section presents data about poverty related issues like health, consumer items, financial position and housing. Further, in the third section, land use and tenure systems will be elaborated. An analysis of collective action, formal and informal organisations follows in the fourth section. In the fifth section, involvement in aquaculture production and marketing, in section six regression analyses in regard to project membership are presented. The last section summarises the findings.

[191] In 2.5 percent of the interviews, either the brother/sister, father/mother in law or the son/daughter in law of the HH head were interviewed.

5.2 Socio-demographic household member data

General information concerning the sample

Male and female HH members are equally represented in the survey with 49 percent male and 51 percent female HH members included. HH members are between 0.25 and 95 years old (mean 28.34; std. dev. 18.2), whereby the under 30 years old represent 62.1 percent of the whole sample. Family sizes lie between one and 14 members, with a mean of 6.6 members (std. dev. 2.32). Most people are married (49.2 percent) or single (46.3 percent) and only 4.5 percent are widowed.[192]

In Cambodia, all respondent HHs (n=88) indicate that they are Khmer and Buddhists; in Vietnam (n=72), respondent HHs belong to the ethnic group of the Kinh. In E2 hamlet, all respondents are Catholics. Only in TPB more diverse religions are represented. The majority of HHs here are Buddhist (64 percent), while 30.6 percent indicate they are free thinkers and 5.6 percent belong to the religious group of the Hoa Hoa. The CBFC project group in TPB, for example, involves at least eight Buddhists, two free thinkers and one member of the Hoa Hoa.

Education and Occupation

Figure 13 shows the years of education in the research villages in percent of all adults. On average, adults (age 18 or older) have 6.14 years of education, whereby men enjoyed on average 0.93 additional years of education in comparison to women (Mann-Whitney: $z = -3.661$; $p<0.001$)[193]. Forty-six percent of all adults went to primary school and 30.7 percent visited secondary school. Only six and five percent respectively visited higher schooling or hold a university degree - all of them being Vietnamese. The difference between the years of education in the Vietnamese hamlets and the Cambodian villages is also statistically significant at the one percent level and adult Vietnamese have on average 1.9 years more education than adult Cambodians (Mann-Whitney: $z = -6.960$; $p<0.001$).

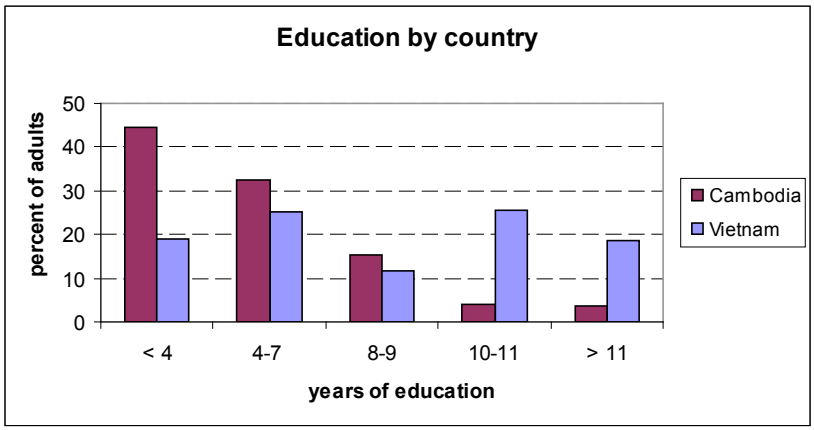

Figure 13: Years of education by country (adults with age >= 18; n=559)

[192] Figure 64 in the Appendix shows the box plots for family size and age by country.
[193] The Mann-Whitney test is used to measure the significance of the distribution, e.g. whether two independent distributions come from the same universal set.

When asked about their occupation, 68.1 percent of the adults name "cultivation of own land" as their primary occupation. Five percent are "factory workers" and 4.4 percent "students". In sum, only 0.5 percent of HHs mention the involvement in "fishing", "aquaculture" or in "fish gear making" as their first occupation.[194] Overall, disregarding the rank of occupation and the age of the HH member, 53.4 percent of all HH members are involved in land cultivation, 22.4 percent are students. Further, 10.6 percent of HH members mention to be a housewife and 6.6 percent work in a factory or shop. Only 4.1 percent are involved in the fishing sector (fishing, fish trading, fish gear making) and four percent in aquaculture activities.[195] Cross tabulating the different occupations with the member type (e.g. HHH, son/daughter) it appears that different members are responsible for different activities. Fishing is something that is rather done by the HHH him- or herself, while in land cultivation mostly sons/daughters are occupied. Aquaculture production is done mainly by HHHs and their direct offspring.[196] Figure 14 shows pie diagrams of land cultivation, fishing and aquaculture, indicating the share of HH members being involved in these activities.

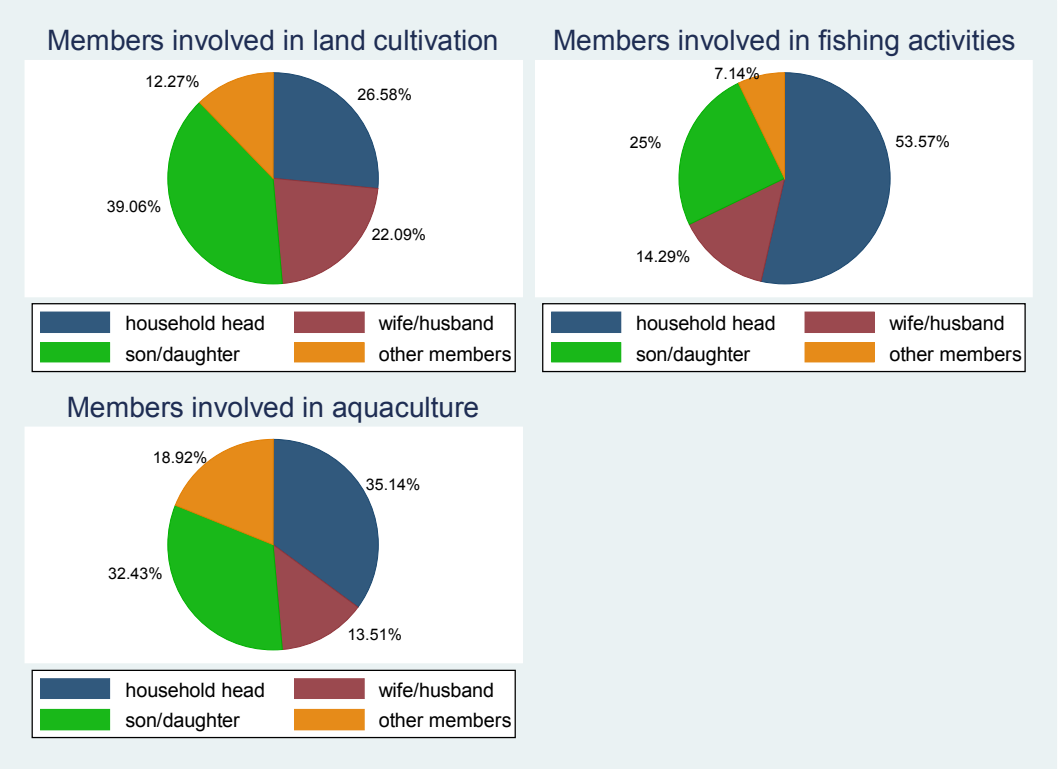

Figure 14: Involvement of HH members in land cultivation, fishing and aquaculture (n=554)

[194] As the main secondary occupation of adult HH members "housewife" is mentioned (7.9 percent). However, also "fishing/harvesting of wild aquatic produce" (2.3 percent) and "aquaculture production" (2.9 percent) are mentioned. As third occupation "other non-skilled worker" (1.3 percent), "aquaculture production" (0.9 percent) and "small livestock/poultry producer" (0.7 percent) are named. Six people (0.7 percent) further have "fishing gear maker" as a fourth occupation. Figure 65 in the Appendix provides an overview about the different occupations mentioned for the HH members.

[195] This is not in line with the data collected with the HH list in section 4.2.1. Here, 16 percent of all HHs in the four villages were indicated to engage in seasonal commercial small-scale fishing. However, seasonal fishing might not be seen as a "real occupation" and was thus not mentioned when HHs were asked about their occupations. In the HH list it was explicitly asked about seasonal fishing activities, which might explain the higher rates.

[196] Male and female offspring are approximately equally presented in all three occupations.

Differences in regard to occupation between the countries are small. While in Cambodia 77.4 percent name "cultivation of own land" as primary occupation, this figure is slightly smaller in Vietnam, where 60.7 percent name it as their first occupation. In contrast, the amount of students is much higher in Vietnam with 10.1 percent compared to only 2.4 in Cambodia. Differences in regard to involvement in fishing are neglectable. Further, members as well as non-members of the project show no differences in regard to their occupation.

Remittance activities

Only 7.9 percent of all HH members spend at least one month away from the village.[197] Nevertheless, the members in remittance represent 28.1 percent of all HHs in the sample, thus at least a quarter of the respondent HHs have a member in either long- or short term remittance. However, looking at the HHs that indicate that one (or more) family member sent income to the HH last year, 33.8 percent indicate that they had a family member that did so. This leads to the hypothesis that members that are away for most of the year are not considered as HH members in that sense and were thus not listed as HH members in the first place. The average amount of income sent home in the last year was 259.9 US$ (std. dev. 712.58). The amounts sent to support the rural family lie between 2.5 US$ and 3,750 US$ per year. Of the project HHs, 29.6 percent are having a member in remittance, while 40.7 percent indicate they receive money from a HH member that lives away from the village.

To summarise, all villages can be considered as rural communities with less education and "land cultivation" as the main occupation of the community members. The involvement in fishing is not seen as main occupation, but must be rather considered as an additional activity contributing to the diet of the HHs. Although only four percent mentioned fishing or aquaculture as a formal occupation, nearly 50 percent of the HHs are involved in aquaculture (e.g. processing of aquaculture produce, marketing). The remittance activities by a large share of the community members influence the project implementation in two ways. First, those HHs who have members transferring money might lack labourers to fulfil additional responsibilities within the project. These HHs might be reluctant to join the project due to time constraints. However, on the other hand, those HHs receive financial means from the members in remittance and might thus, in contrast, be rather able to join the project as they can afford paying the financial contributions required for participation. Thus, the occupation (in combination with the education) plays an important role for the project implementation and might determine the likelihood of participation.

[197] In TK village, where farmers reported that young community members could not participate in the project as they migrate out of the village, the percent of HHs with members in remittance is highest with 59 percent of HH members engaging in such activities.

5.3 Poverty issues in Cambodia and Vietnam

This section aims at increasing the understanding of poverty based on more formal criteria than in the action research analysis, where poverty indicators were developed by the farmers in the villages themselves. Thereby, this section contributes to a better comparison between the villages and between the two countries.

Health

Overall, more than 74.8 percent of the HH members had a health status described as "healthy", 15.3 percent suffered from an "acute illness" at the time of the interview and 9.1 percent are "chronically ill" or "disabled" (n=924). However, when asked about specific sicknesses, for only 39.3 percent of the HH members no sicknesses are reported. The remaining 60.7 percent are reported to have suffered mainly from dysentery (54.9 percent), fever (9.6 percent) or chronic fatigue (8.1 percent) over the last year. Noteworthy, in Cambodia, health problems are reported for each single HH member as 100 percent of all HH members suffer from dysentery. In Vietnam, only 14.4 percent of the HH members are reported to suffer from a sickness at the time of the interview.

Consumption patterns

When looking at consumption patterns, it becomes obvious that fresh fish plays a dominant role in the daily food consumption of the respondents with 98.1 percent of HHs indicating that they consumed fish during the last seven days (n=160). Further farmed meat was consumed by 77.5 percent, aquatic plants by 60.6 percent and processed fish (fermented, dried, canned or smoked) by 54.4 percent of the respondent HHs. In contrast, the consumption of dairy products is rather low with only 38.1 percent. Figure 15 summarises the percent of HHs that consumed the respective items over the last seven days before the interview. Most of the fish and meat is either purchased from mobile vendors (44.9 percent) or harvested by the family (19.8 percent).[198]

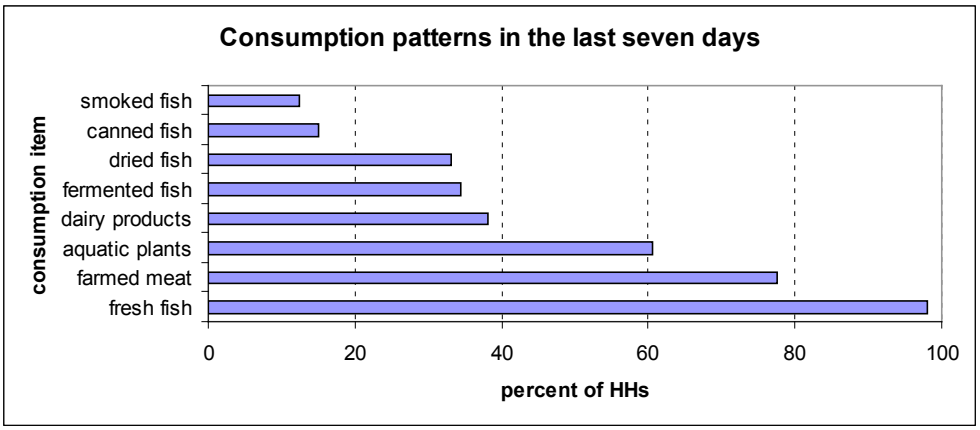

Figure 15: Consumption patterns of HHs in the last seven days (n=160)

[198] The Vietnamese HHs rather consume fresh fish (66.3 percent of HHs), while the Cambodians also consume all forms of processed fish. The consumption of meat and dairy products is similar in both countries.

When looking at the mean kg consumed by the HHs within the last seven days, the importance of fish in the diet of the respondents becomes even more evident (see Figure 66 in the Appendix). Silver carp with six kg consumed by the average HH is the most important source of animal protein intake. Important is also to mention the high amount of wild river fish consumed by the respondent HHs (2.5 kg on average). In contrast, beef, but also pork and poultry are not eaten in a large quantity, which can be partly explained by the high prices farmers pay on average for those goods (see Figure 67 in the Appendix).[199] Cultured fish/meat plays a meagre role in the consumption patterns with only 7.7 percent of fish and meat consumed coming from own culture (Figure 16). In Vietnam, 17.2 percent of HHs consumed fish from own culture, while in Cambodia only 6.3 percent of the respondent HHs did so. The Cambodians rather buy fish from roadside vendors or periodic markets.

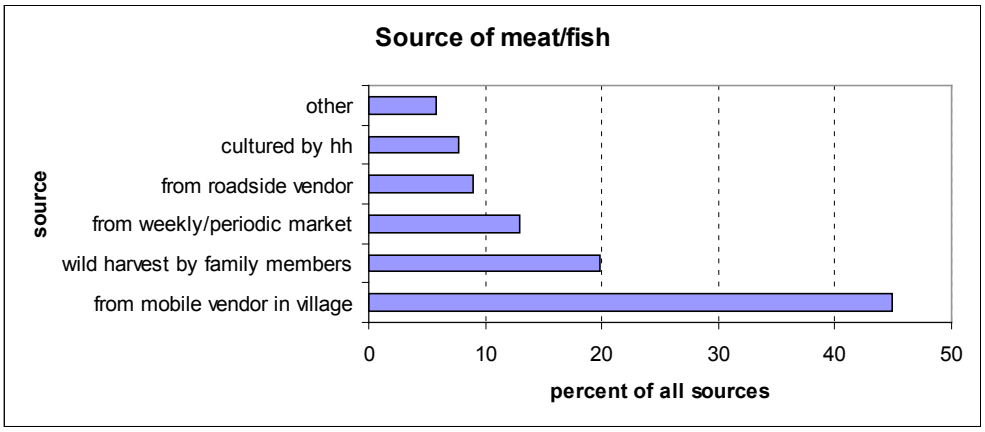

Figure 16: Source of meat and fish

Only 60.6 percent of the respondents answered the question on how many month the HHs has to cope with less than three meals per day. Looking at those, Cambodians (n=69) have less than three meals in 5.8 months on average (std. dev. 4.48). In Vietnam (n=28), farmers eat less than three times in 7.8 months (std. dev. 5.05).[200] However, when looking at "reduced meals" (50.6 percent of respondents), where farmers were asked in how many months they have to reduce the quantity or quality of their meals, the Cambodian (n=70) respondents eat reduced meals in 8.5 months (std. dev. 3.76) and the Vietnamese (n=11) only in 0.27 months on average (std. dev. 0.65). This is a statistically significant difference at the one percent level (Mann-Whitney: $z = -4.9$; $p<0.0000$). Thus, having two meals per day only seems to be rather common in Vietnam and having less than three meals per day is not an indicator to suffer from a food shortage.

Consumer Items, Livestock, Agricultural and Aquatic Production Assets

When comparing property possessions by country (Figure 68 in the Appendix), it becomes obvious that Vietnamese HHs can afford more consumer items on average than the Cambodian HHs. However,

[199] The correlation between kg consumed and prices is, however, not significant (Pearson correlation=-0.0563; $p<0.1189$). The Pearson correlation reflects the degree of linear relationship between two variables. A correlation of +1 (-1) means that there is a perfect positive (negative) linear relationship between variables.
[200] This difference in the mean is statistically not significant (Mann-Whitney: $z = 1.763$; $p<0.0778$).

the Cambodians seem to rather invest in production items and livestock and possess more of these on average than the Vietnamese.[201] This is in line with the occupations indicated above, where 64.4 percent of the livestock raisers/traders and 55.2 percent of the fishers are Cambodian. Thus, the higher endowment with livestock and fishing gears can be explained. Also, the percentage of villagers involved in land cultivation is higher in Cambodia (63.2 percent versus 41.8 percent in Vietnam) and thus also the higher endowment with agricultural production items can be explained. Nevertheless, the possession of consumer items is a good indicator for the wealth status and obviously the Vietnamese HHs are better-off than the Cambodians as they can afford more consumer items.[202]

Credits, Savings and Borrowings

In Vietnam, 33.3 percent of HHs were required to borrow at least part of their income in the last year. Almost 14 percent had to borrow more than 75 percent of their income. In Cambodia, only 6.8 percent needed to borrow more than 50 percent of last year's income. However, here 67.1 percent had to borrow up to 25 percent of their income in the last year and (Figure 17).

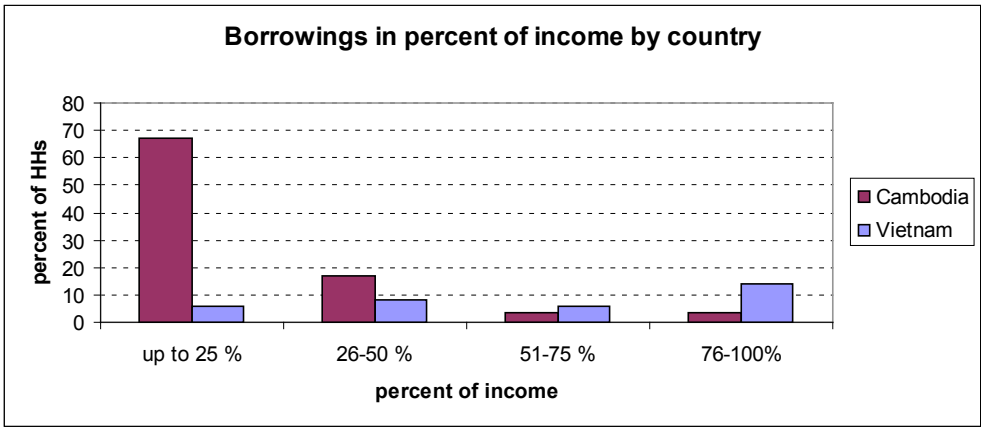

Figure 17: Borrowings in percent of income by country (n=104)

Of all credits taken (n=166, multiple answers possible), 23.5 percent were used for unspecified domestic purposes. Thirteen percent were taken to pay medical expenses (see Figure 69 in the Appendix). Differences between the countries cannot be observed. Overall, credits were mainly borrowed from local money lenders (31 percent), from rural development banks (22.1 percent) and

[201] Consumer items include TV, radio, fridge, mobile and land phone, electric fan, sewing machine, cooker, stove, bike, motor bike, car, truck, car battery, solar panel, personal computer. Production items include: tractor, irrigation pump, well, generator, boat, boat motor, plough, animal cart, threshing machine, rice mill, pesticide sprayer, tool cutting machine. Livestock covers milk cattle, draft cattle, buffalos, goats, sheep, pigs, chicken, ducks, donkeys, horses. Besides traditional fishing gears, gillnets, individual traps (baited), barrage traps, cast nets, long line hooks, two handed nets, triangular nets, long line (baited), hand traps, seine nets, harpoons, hook and line, lift nets, trap cages are covered here under fishing gears.

[202] For many of the consumer items mentioned it is also necessary to have access to electricity which the Cambodian HHs do not have.

NGOs (18.3 percent).[203] Overall, the mean amount borrowed is 623.7 US$ (std. dev. 2025.1) and credits range from five US$ to up to 5,000 US$.[204]

Further, 41.9 percent of all respondents indicate that they were not able to save any of their income. The percentages of savings by country show that most respondents in Cambodia (87.5 percent) were not able to save anything or less than a quarter of their income. Only 3.4 percent of the Cambodians managed to save more than half of their income, while this was possible for 16.7 percent of the Vietnamese respondents (Figure 18).

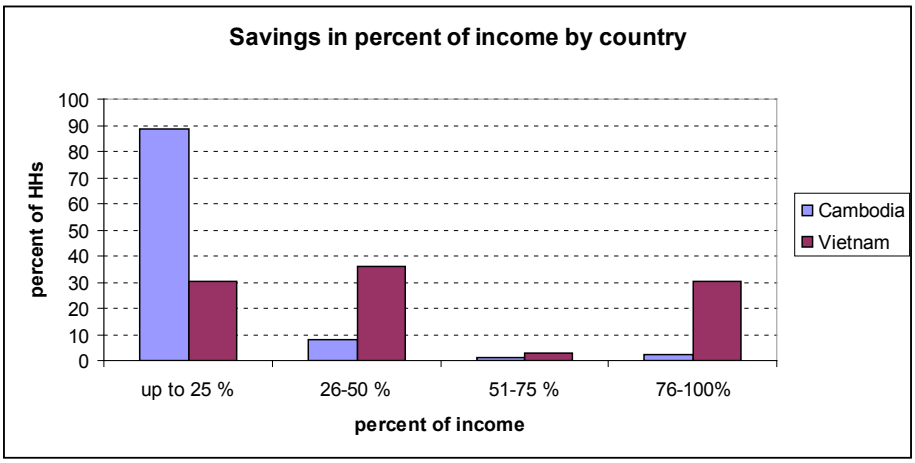

Figure 18: Savings in percent of income by country (n=123)

Housing

Respondents were asked to name the time when the oldest HH on the compound as well as their own HH was established.[205] The mean years of HHs establishment differ significantly at the one percent level between Cambodia and Vietnam (Mann-Whitney: "oldest HH" $z = 9.451$; $p<0.0000$ and "this HH": $z = 8.358$; $p<0.0000$). In Cambodia, the oldest HHs on the compound has an average existence of 12 years only (std. dev. 10.2). In Vietnam, the picture is very much different, with the oldest HHs being established 46.7 years ago on average (std. dev. 24.0). This is similar for the respondents HHs with 11.7 (std. dev. 10.3) and 40.8 years (std. dev. 24.6) respectively of existence (Figure 19).

[203] Cambodians rather borrow from local money lenders and NGOs, the Vietnamese from rural development or savings banks. Informal rotational saving schemes only play a meagre role for credits. See Figure 70 in the Appendix for a detailed overview of credit sources.
[204] The highest credits are taken for house repairs (mean 1295.83; std. dev. 1646.51).
[205] Most of the families have one housing unit only (78.8 percent). However 16.9 percent have two housing units on their compound and 4.3 percent three or even four.

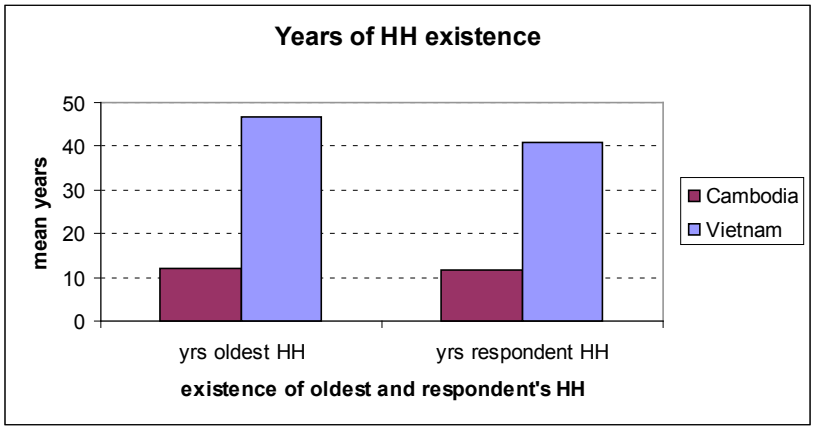

Figure 19: Years of existence of oldest and respondent's HH by country

The total house area is 66.6 m^2 (std. dev. 51.9) and the total homestead area is on average 1,360.8 m^2 (std. dev. 1333.2).[206] Looking at the box plots in Figure 20 it can be observed that Vietnamese houses encompass larger areas with a higher mean of 98.3 m^2 (std. dev. 59.7) in comparison to the Cambodian houses that encompass only 40.1 m^2 on average (std. dev. 20.7). However, looking at the total homestead area, the Cambodians live on larger pieces of land with about 1,699.9 m^2 on average (std. dev. 1446) in comparison to only 840.1 m^2 (std. dev. 932.7) in Vietnam.[207]

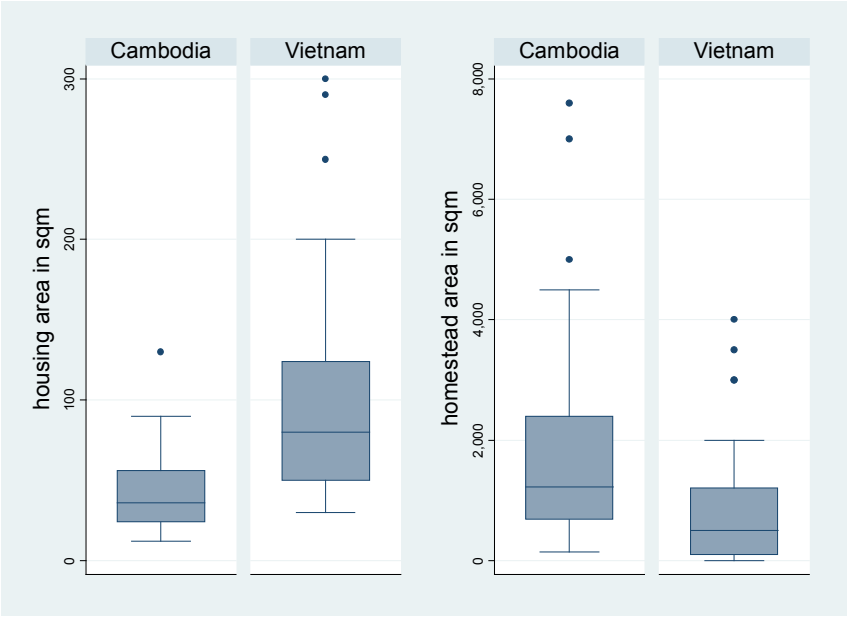

Figure 20: Box plot showing the distribution of total house and homestead area by country[208]

[206] On average, villagers live very close to each other with only 23.4 m (std. dev. 69) of distance to the next neighbour, with the Vietnamese living significantly closer to their neighbours (Mann-Whitney: z = -6.604; p<0.0000).

[207] Both differences of house size and homestead size are significant at the one percent level. (Mann-Whitney "house": z = -8.169; p<0.000; Mann-Whitney "homestead": z = 4.382; p<0.000). The data about the size of the homestead area was cross-checked with data collected in regard to land tenure, where homestead size was indicated as well. Here the average homestead land is even larger with a mean of 1587.1 (std. dev. 1883.41). The differences between Cambodia and Vietnam can be observed here as well.

[208] The box plot provides the 25th and 75th percentile (bottom and top of the box), the lower and upper quartiles and thus shows the standard deviation. The band near the middle of the box represents the median. The box shows the area in which 50 percent of all data lies. The "whiskers" (adjacent lines) represent upper and lower adjacent values. Small dots outside of the box and whiskers represent outliers.

While 98.6 percent of the Vietnamese indicate that they use electricity as the main light source, no Cambodian has access to electricity. Here, batteries (53.4 percent) and generators (32.9 percent) are mainly used as light source. A main difference can also be found in regard to the toilet type used by the respondents. In Vietnam, 48.6 percent of farmers have a water-sealed toilet and 34.7 percent a pond latrine. In Cambodia, most people (72.3 percent) must use the rice field for toiletry. Only 14.5 percent have a pond latrine. Vietnamese use mainly piped water (40.3 percent), rainwater (45.8 percent) and purchased water (11.1 percent) as drinking water source. In Cambodia, main drinking water source are wells with 52.9 percent using tube or pipe wells and 44.7 percent open wells. In both countries, firewood is used mainly as cooking fuel (96.6 percent in Cambodia, 78.9 percent in Vietnam). However, 15.5 percent of the Vietnamese also use petroleum.

Livelihoods Trends and Needs

Respondents were asked how their overall livelihood security has changed over the last five years. While the majority in Cambodia is convinced that their livelihoods had improved (a total of 71.6 percent answered "significantly and marginally improved"), the Vietnamese respondents rather said it is "roughly the same" (39.9 percent) or "marginally improved" (29.2 percent). In Vietnam, there are also 29.2 percent convinced that their livelihoods deteriorated in the last five years, whereby in Cambodia, there were only 6.8 percent having this opinion (Figure 71 in the Appendix).

Respondents had the possibility to indicate what made their life better in the last five years (multiple answers possible). In Cambodia, 293 reasons were given for an improvement of the livelihoods. In Vietnam only 71 answers were given. Overall, the three most important reasons why livelihoods improved are related to livestock, the rice harvest and the housing situation.[209] However, while in Vietnam the rice harvest (23.9 percent) and the high prices realised through selling crops (22.4 percent) dominate the answers, the Cambodians find their livelihoods improved mainly through more/healthy livestock (17.6 percent) as well as improved housing (15 percent) and more assets/higher living standard (14.3 percent).

The respondents were also asked what made their livelihood worse in the last five years. In Cambodia, 250 reasons were mentioned, in Vietnam 76 answers were given (multiple answers possible).[210] Most influential for a deterioration of livelihoods are high education costs, mentioned in 25 percent of all answers. However, also sick/dead/small amount of livestock is an important concern for the respondents (24.7 percent). Differences for Cambodia and Vietnam can be mentioned as the Vietnamese suffer mainly from insects and/or rice diseases (22.2 percent), the Cambodians from high education costs (27.8 percent) and bad conditions for livestock keeping (27.3 percent).

[209] Figure 72 in the Appendix summarises the ten most often mentioned reasons in percent of all answers for both countries.

[210] The ten most frequently mentioned responses are summarised in Figure 73 in the Appendix as percent of all answers.

The results concerning poverty influence the project implementation and the adoptability of the community-based approach. Further, these indicators might also determine who participates in the project and who is not willing or not able to participate, e.g. the health status might influence the possibility to participate in the project in terms of contributing labour, but also in regard to financial means as sicknesses also add burden to the financial budget. The consumption patterns were analysed in order to better understand preferences of Cambodian and Vietnamese HHs and thereby also identify whether the cultured fish would contribute to a higher food security which was envisaged by the project. Although fish plays the dominant role in the protein intake of the rural HHs, they are rather bought or harvested in the wild than cultured by the HHs. Thus, the culture of fish might contribute to the HH well-being in two ways. Fish that is usually bought could be substituted by the cultured fish and expenses could be saved. On the other hand, time that is usually spend for catching wild fish could be used for other activities when the wild fish is substituted with the cultured fish. Thus, from this perspective, the project bears incentives for HHs to participate. In terms of food security, it is the Cambodian HHs that suffer mainly from reduced meals and less food security. Increasing the amount of fish available to the HHs as envisaged by the project could thus contribute to more food security in the Cambodian villages. The data provided in regard to consumer items and borrowings/savings give further insights into the differences concerning wealth in the two countries. Overall, the Cambodians are less well-off than the Vietnamese. However, in both countries, HHs borrow money for different reasons, mainly to cover medical expenses. Borrowing and saving behaviour is however important in regard to the project implementation as it influences financial means that are available for participating in the collective project. Also, looking at the livelihood trends, the importance of livelihood diversification becomes obvious as livestock keeping and rice cropping were mentioned to be vulnerable to diseases and the spread of insects respectively. Thus, the aquaculture project could function as an additional income-generating activity that reduces the vulnerability by diversifying livelihoods.

5.4 Land use and tenure

Land use, land size and cropping patterns

All HHs (except of 2.3 percent of the Cambodians) use a piece of land as their homestead. However, looking at crop land, one key difference between the countries can be observed. In Vietnam, the majority (90.3 percent) uses flooded/irrigated annual-crop lands, whereby in Cambodia, 79.6 percent farm on rain-fed annual-crop lands (in comparison to only 26.1 percent on flooded/irrigated annual-crop lands). Thus, Cambodians mainly rely on rain waters for irrigation and are thus heavily dependent on the annual rainfall. In Vietnam, most farmers profit from well-developed irrigation systems. It is also in Vietnam, where a quarter of the sample has a pond. In Cambodia it is only one HH (Figure 21). Overall, this shows clearly that farmers face different basic agricultural differences that influence not only the harvest of rice, but many other factors in regard to agriculture and

aquaculture. Thus, the projects in both countries are implemented under very different natural conditions, which is important to consider when looking at the implementation as well as at the outcomes.

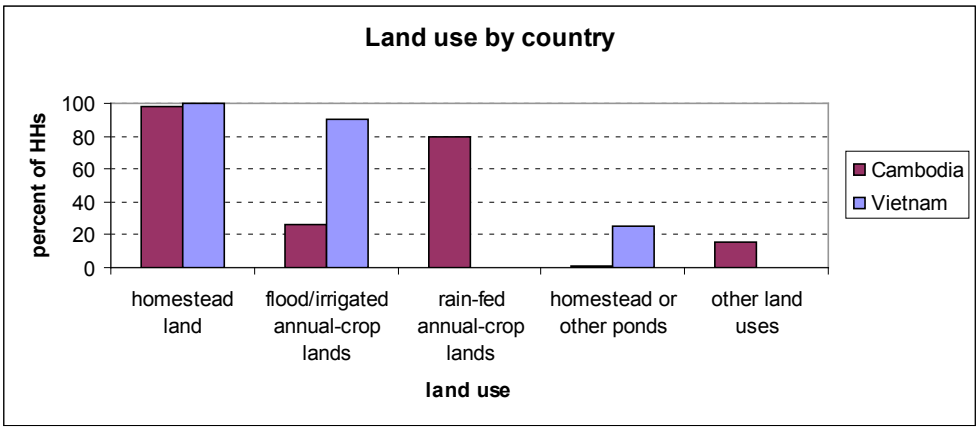

Figure 21: Land use by country in percent (n=160)[211]

The mean number of plots over the whole sample is 1.56 (std. dev. 1.28). The number of plots used in both countries is, however, significantly different at the one percent level and Vietnamese use 0.8 plots less than the Cambodians (Mann-Whitney: z = -5.981; p<0.000). The size of annual-crop land (either flood/irrigated or rain-fed) is 0.9 ha on average (std. dev. 0.93). Also here, significant differences between Cambodia and Vietnam can be observed. The box plot in Figure 22 summarises the data about the land size of annual crop lands by country, which is 0.58 ha on average in Cambodia and 1.24 ha on average for Vietnam.[212] Thus, most Vietnamese possess more land on average, which is also irrigated in 90 percent of the cases (and not rain-fed like in Cambodia).

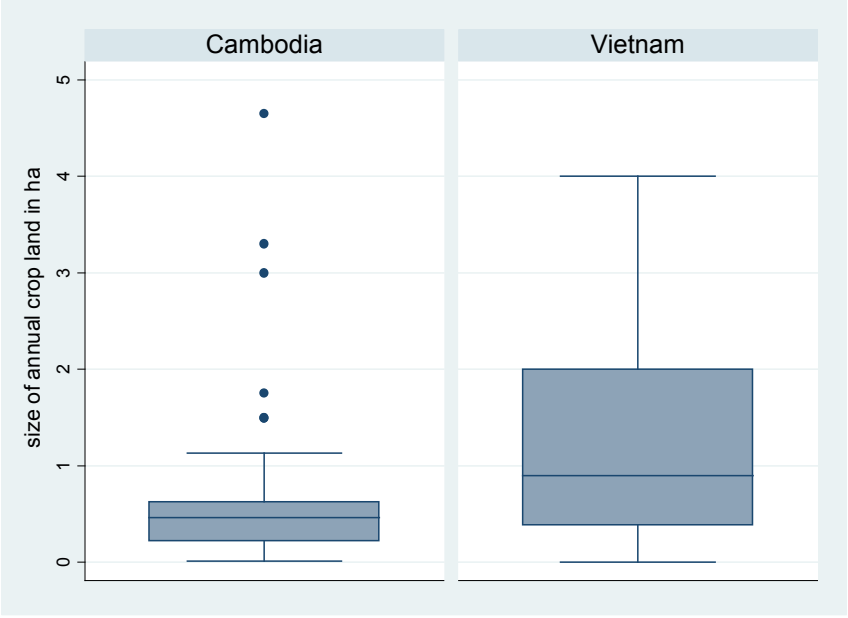

Figure 22: Box plot of annual crop land size by country

[211] Other land uses in Cambodia that count for 15.9 percent of all respondents include alternate rain-fed/irrigated cultivation, plantation of perennial crop land, pasture lands, scrub/forest lands, non-productive waste lands and land that is owned, but cultivated by others.
[212] This difference is statistically significant at the one percent level (Mann-Whitney: z = -4.301; p<0.0000).

The Vietnamese respondents explain that most of their cropping plots are visible from their homestead. The majority of the Cambodians did not answer this question, but those who did rather say that none of their plots are visible from their homesteads.[213]This is an important indicator when considering guarding and poaching.

As the main crop cultivated, HHs indicate rice in 61.8 percent of the cases. Almost 28 percent grow fruits, 8.5 percent grow vegetables and two percent cultivate fish. Figure 23 shows the summary of all crops, including fish, mentioned in percent of all answers by country (multiple answers were possible). In Cambodia, fruits are the crops cultivated the most with 46.1 percent of all crops mentioned. In Vietnam, fruit cultivation only accounts for 20.4 percent of all crops. Here, rice culture dominates with 63.3 percent. Fish culture is mentioned in 11.2 percent of the cases, but only in Vietnam. Of these 11 HHs, three are in E2, eight in TPB.[214] Over 54 percent of the fish is cultured in rice fields and also vegetables and fruits are grown in rice fields (76.2 percent and 40.8 percent of all vegetables and fruits respectively). In contrast, only 4.7 percent of the rice is grown on homestead land.[215]

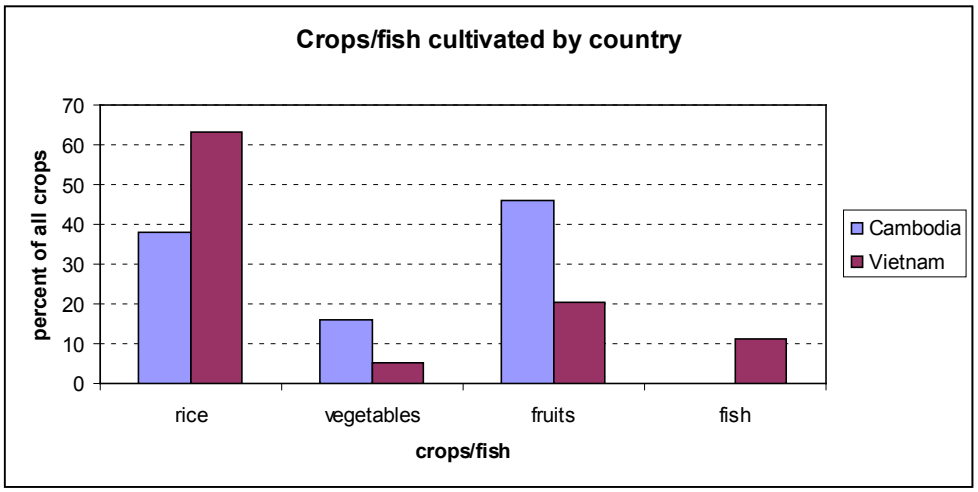

Figure 23: Crops/fish cultivated by country (n=160)

The average rice harvest is significantly different for the two countries with Vietnamese harvesting more rice per ha on average (Mann-Whitney: $z = -7.435$; $p<0.0000$). In Cambodia, the average rice harvest is 1.4 tons/ha (std. dev. 1.39); in Vietnam farmers harvest six tons/ha (std. dev. 2.72) on average. This difference is mainly due to the advantages of irrigation the Vietnamese farmers have. This does not only increase the yield per ha, but also enables farmers to generally realise up to three harvests per year. When looking at the percent of rice sold by the HHs in the last five years, one sees that rather Vietnamese HHs are producing rice surplus than the Cambodian HHs. In Vietnam, more than 80 percent of the rice harvest was sold on average, whereby the Cambodian HHs only sold 30

[213] Figure 74 in the Appendix summarises the answers in a diagram.
[214] Thus, not all pond owners (18 in total) indicated that they also culture fish.
[215] However, this does not come from the effect that these HH do not possess annual crop lands, they rather grow rice on their homestead additionally.

percent of their harvest in the last five years. While the Cambodians consume most of their harvest themselves, Vietnamese HHs can sale a large share of the rice harvested. Figure 24 summarises the percent of rice sold in the last five years for each village in box plots.

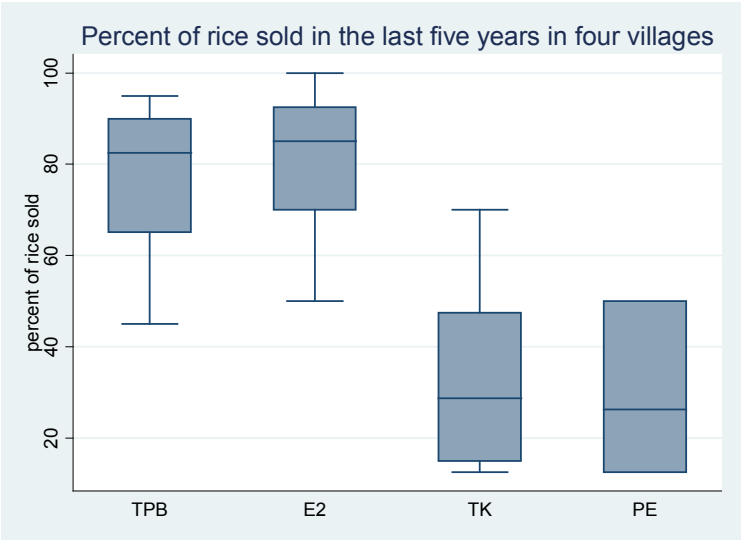

Figure 24: Box plot showing the distribution of percent of rice harvest sold in four villages

Land tenure

In total, the 160 respondent HHs were holding 334 different plots.[216] More than 95 percent of the land used is claimed to be "owned by the resident HH". Only 2.9 percent are "owned by the extended family living on the same homestead", 1.2 percent owned by extended family in the same village and one respondent indicates that his land is owned by the extended family outside the village (Figure 75 in the Appendix). However, respondents were also asked to specify the kind of land rights (e.g. official title or use rights) for each plot they live on or cultivate. Here, the figures are different, but only slightly. Overall, 27.6 percent of the Cambodian parcels were claimed to be "legally owned with title based on official survey". In Vietnam, 85 percent have a legal title based on an official survey.[217] In the two Cambodian villages more diverse tenure systems are found. All annual crop lands in TK are owned with a "legal title based on formal survey", but only 82.1 percent of the homestead lands. In PE, tenure systems for annual crop lands are diverse, for homestead land 20 percent of the farmers have only temporary use right. The following pie graphs show the distribution of land titles in each of the villages for homestead land and annual crop lands (Figure 25). Data on fishing rights for the different plots is only available for 36.4 percent of all parcels. However, at least 18 percent of all parcels are legally accessible for fishing by the whole village and/or the neighbouring villages. Less than three percent are fished by the land owning family only (Figure 26).

[216] The following numbers thus correspond to a sample of n=334.
[217] Data on land titles is missing for 66.8 percent of all parcels in Cambodia and for 12.4 percent in Vietnam.

Figure 25: Land titles for homestead and crop lands by village

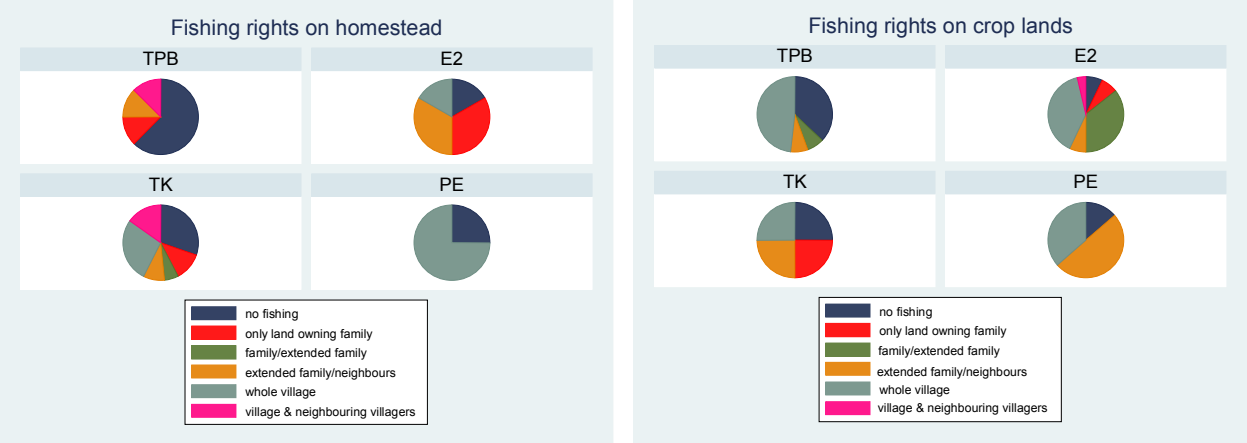

Figure 26: Fishing rights on homestead and crop lands

Respondents were asked to name any tenure change in the last ten years. Almost 56 percent of the changes are related to annual crop land and 38.8 to homestead land. Figure 27 shows the percent of HHs that have experienced a tenure change by country. Overall, the amount of HHs that have experienced a tenure change is high with a total of 77 HHs (48.1 percent of the sample), whereby 67 HHs are in Cambodia.[218] One can identify two peaks of changes, in 2001 and 2006, both more severe in Cambodia. Differences can be observed between the two Cambodian villages with the first peak in 2001 being mostly influenced by the villages of TK and the peak in 2006 by the village of PE. The first peak occurred when the new Land Law came in place in Cambodia in 2001. The second one in 2006 is probably due to the cadastral survey and administration finalised in PE in the year of 2006 (see also section 4.2.5).

[218] In fact, 92 percent of all changes (n=120) are covered by the 67 Cambodian HHs. The remaining ten Vietnamese HHs only experienced a tenure change in regard to one of their land holdings (e.g. either homestead or annual crop land).

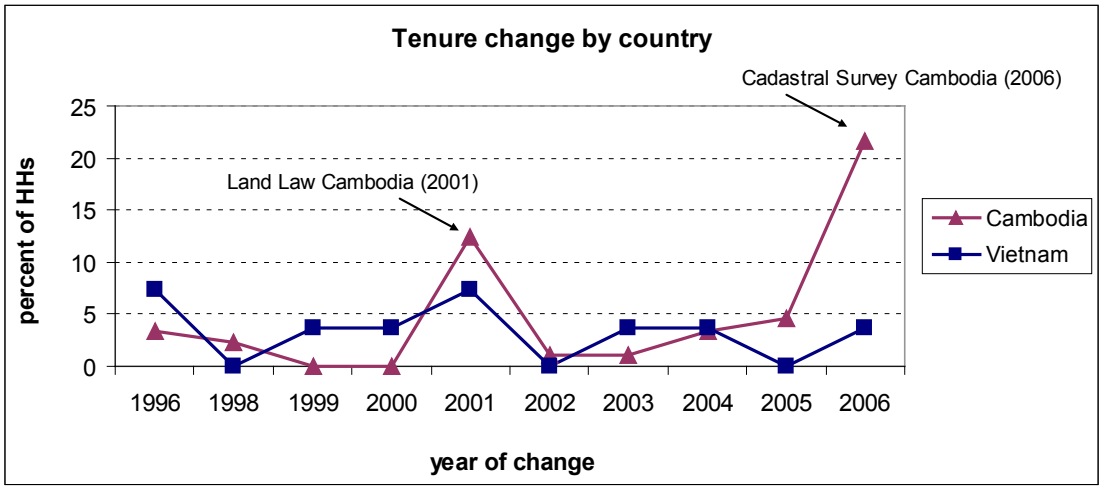

Figure 27: Tenure change by country

Looking at the kind of tenure change (Figure 76 in the Appendix), the peak in 2006 can be explained more precisely. Here, 75 percent of the respondents state that since the change they own the specific parcel. The remaining 25 percent also indicate that the land was distributed to a specific HH to be owned. The peak in 2001, however, shows no such clear change. However, also here 61.4 percent of the respondents explain that since then they or the extended family on the same homestead does own the parcel.

Only 6.9 percent of all respondents HHs report that they have experienced a boundary disputes. More than 63 percent of those boundary disputes are related to homestead land and only 36.4 to annual crop land. And 81.1 percent of the disputes are reported in Cambodia, 80 percent of those in TK village - the only village with no officially registered land titles.

Flood levels and water related difficulties in cropping patterns

When looking at the flood levels in regard to rice fields, essential differences become visible. In Vietnam, 49.2 percent of the land is usually flooded between 100 and 150 cm and none of the HHs indicated that its land lies above flood level. In contrast, in Cambodia, 26.9 percent of the HHs have annual crop land that is usually above the flood level. Only 16.3 percent have land that normally floods between 100 and 200 cm (Figure 28).[219] This also is a good indicator, that the comparison of the two countries in regard to project outcomes is difficult due to the different conditions in the villages. Thus, a direct comparison without taking natural (as well as socio-economic) differences of the two countries into account is not particularly reasonable.

[219] More than 50 percent of homestead owners explain that their homestead land is normally above the flood level. Differences between the flood levels on homestead in Cambodia and Vietnam cannot be observed.

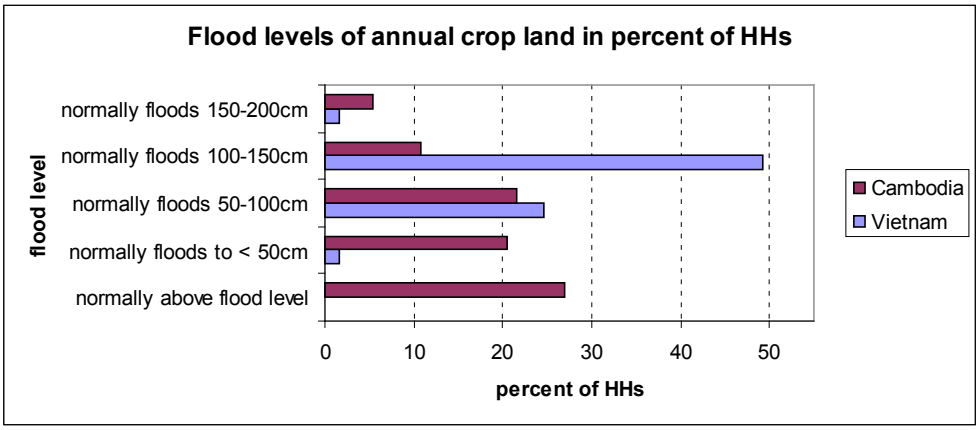

Figure 28: Flood levels of annual crop land in percent of HHs (n=160)

The Cambodian crop lands are surrounded by dikes with an average height of 25.5 (std. dev. 11.21), while the Vietnamese dikes are higher with a mean of 68.1 cm (std. dev. 52.67). When looking at the fish culture sites only, the dikes are much higher with 1.2 m on average (std. dev. 86.16). However, in order to avoid comparing figures that might be misleading due to the different natural conditions, additional indicators were used to understand flooding patterns and to better conclude in regard to the circumstances of agriculture as well as aquaculture. The occurrence of floods in the last five years, for example, is a good indicator on the regularity of flooding. The Vietnamese report that their rice fields were flooded on average 4.6 times in the last five years (std. dev. 1.29). In Cambodia, flooding occurred only 1.4 times in the same time frame (std. dev. 1.15), which indicates that it is much more unstable. The flood duration also differs between Cambodia and Vietnam. Rice fields are flooded above 30 cm in Cambodia for a minimum of 30 days per year on average. In Vietnam, it is only half of the days on average for minimum flooding. In contrast, when floods are more severe, maximum flood levels are reached in Cambodia for 60 days, while in Vietnam for only 30 days. The depth of flood waters within the rice fields fluctuates between a minimum of 62 cm and a maximum of 1.4 m on average in Cambodia. The Vietnamese culture under better conditions as the minimum level of water in the fields is 92 cm and the maximum 1.47 m on average. Overall, when looking at the different indicators presented, it can be stated that the natural and technical conditions for agri- and aquaculture are better in Vietnam.

Figure 29 shows the differences in flood, irrigation and drainage control between Cambodia and Vietnam. While 68.3 percent of the Vietnamese rice culture plots are managed with full irrigation, flood and drainage control (using sluices, distribution and drainage canals), the most plots in Cambodia (59.2 percent) have no or only partial flood and irrigation control. Only 2.9 percent have full irrigation and drainage control with access to dikes as well as to distribution and drainage canals. Thirty-eight percent of the plots however are managed by full flood control (dikes and sluices). In Vietnam, 10.3 percent of the plots are also governed within a pumped village/group or micro-irrigation system. Main irrigation sources for the Vietnamese are gravity (50.8 percent), pumping (24.6 percent)

and recession (20 percent). For the Cambodians it is rather recession (13.9), private ponds (13.9) and gravity (11.9 percent).[220] Thus, it can be summarised that the Vietnamese have a much higher control on water flows, which strongly influences cropping patterns.

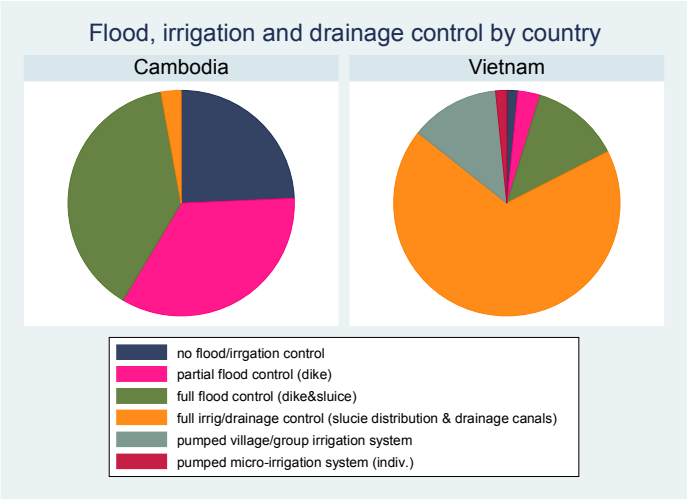

Figure 29: Level of flood control on rice plots by country

Fifty percent of the HHs in the sample report that they face problems related to water availability and/or quality in their rice fields. These include 86.4 percent of the Cambodian HHs, but only 11.1 percent of the Vietnamese HHs. Figure 30 summarises the kind of water problems mentioned by the farmers according to their frequency. Droughts are the most common problem, however, except of one Vietnamese HHs, only Cambodian HHs suffer from droughts (18.1 percent).

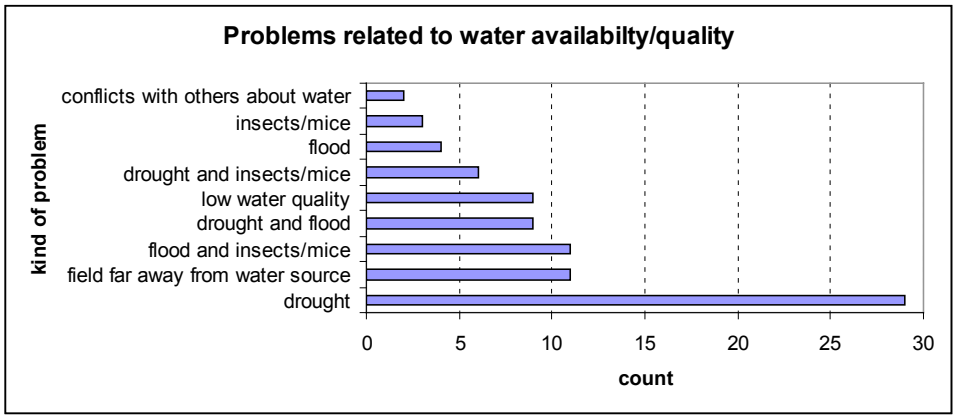

Figure 30: Problems related to water availability/quality in rice fields

To summarise, while most agricultural land is "legally owned based on a formal survey", on most of the parcels, fishing rights are not limited and allowed to anyone. Land holdings are much higher in Vietnam (except for homestead areas) and less fragmented. Rice cropping dominates the cultivation, whereby especially the Cambodians also cultivate fruits. The rice harvest is significantly higher for the Vietnamese, who harvest four times as much as the Cambodians. Vietnamese HHs culture mainly on flood/irrigated annual-crop lands, Cambodians on rain-fed lands. Vietnamese also have much higher flood control in their paddies and flooding is more stable and predictable compared to Cambodia as

[220] See Figure 77 in the Appendix.

infrastructure is much more developed in Vietnam, with higher dikes, more sluices, drainage and distribution canals. Most Vietnamese have full irrigation and draining control on their parcels. Accordingly, problems related to water availability and water quality (e.g. droughts and flooding) are reported mainly by the Cambodians. Vietnamese do not synchronise the field preparation, duration of crops and water release as much as the Cambodians do. However, this might be due to the fact that the Vietnamese rather have the possibility to individually decide on these issues and the Cambodian HHs rely on synchronisation. Disputes in regard to water are mainly reported by Cambodian HHs.

Overall, it can be summarised that the conditions for fish culture are much better in Vietnam as a higher flood control is possible, flooding occurs on a regular basis, plots are visible from homesteads and the Vietnamese seem to also have higher control concerning fishing access by other HHs on their plots. The next section will focus on the membership in formal self-help groups as well as informal cooperation within the villages, which is considered as key for answering the research questions as well as for implementing a community-based approach where collective action is required.

5.5 Collective action, formal and informal cooperation

Twenty-five percent of all HH members age 18 or older (n=634) are a member of a formal organisation in their village. Of those, the Cambodians constitute nearly 69.8 percent. The majority of organisational members are HHH (60.4 percent). More than 87 percent of the organisational members are only ordinary members, leaving less than 13 percent fulfilling a position as president, treasurer, and secretary or for other executive duties. The years of involvement are rather low and 47.7 percent are members in their organisation for less than five years. The amount of organisations in the villages differs only marginally with six organisations in TPB and PE, seven in TK and only five in E2. Overall, twelve different organisations were mentioned.[221] The highest amount of members can be found in the NGO micro-credit organisation, in which 160 Cambodian HH members participate.

Collective activities the organisational members are involved in include guarding fields, public health activities, procuring agricultural inputs and fish seed supply as well as political meetings, micro savings/credit and other.[222] The activities mentioned most often are “guarding fields” (13 percent of all activities), “public health activities” (11 percent) and “procuring agricultural input” (10 percent). “Guarding fields” is the most important activity for the members of the rice-fish group, who also mention “procuring fish seed supply”, “maintenance of dikes/irrigation works” and “collective fishing” as their main activities. Looking at the mean number of meetings attended by the participants,

[221] These include the following: NGO micro-credit (130 members), political organisation (19), church/temple society (16), rice-fish organisation (14), village development organisation (12), farmer organisation (9), fishing society (6), youth group (5), collective public work (5), village welfare organisation (4), government micro-credit (2), women's group (1).

[222] Members of the NGO micro-credit organisations are the ones most involved in diverse activities. In contrast, the women’s and youth groups only focus on one specific activity.

the church/temple society, the women's group and the government micro-credit organisations meet most often with 12 meetings per year on average. However, when asked about informal collective agricultural activities the HHs undertake with other HHs in the village on a collective basis, 107 HHs representing 66.9 percent of the whole sample explain that they are involved in such activities. The frequencies of the different activities are presented in Figure 31. Fifty-two percent of all HHs in the sample work collectively for field preparation, 50 percent in maintaining public spaces (buildings/roads/temples) and 48.1 percent support each other during transplanting times as well as for crop security/guarding activities. Collective fishing is done by 23.1 percent of all HHs in the sample.

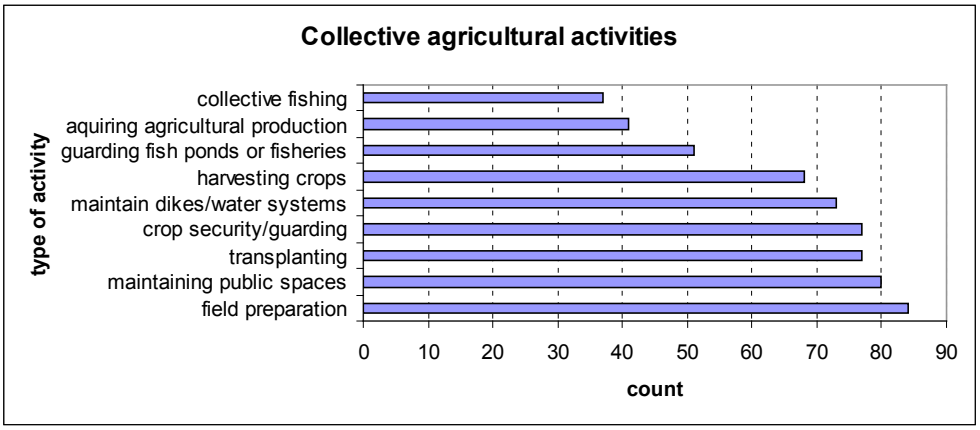

Figure 31: Informal collective activities (n=107)

The motivation for collective activities differs between the villages and is diverse, with "reciprocal labour arrangement" being the reason in more than 45 percent of the activities. However, also "financial remuneration" plays a role when deciding to engage in collective activities. While in Cambodia the "reciprocal labour arrangement" and "financial remuneration" dominate, in E2 "achievement of a shared common good" is the main reason for engaging in collective activities (more than 75 percent). In TPB, also the "reciprocal labour arrangement" is used as motivation for supporting each other (Figure 32).

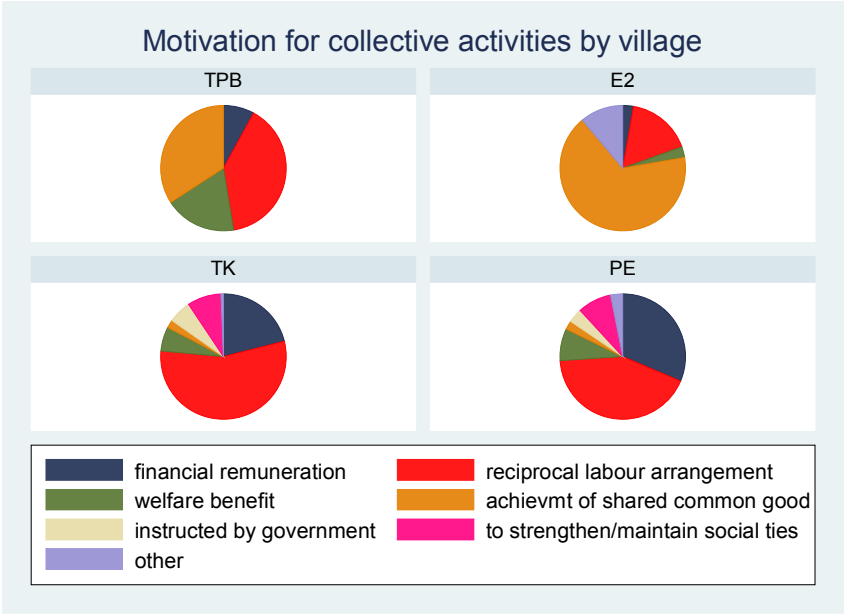

Figure 32: Motivation for engagement in collective activities by village

Seventy percent of all these activities are based on relationships within the village, but 24 percent on relationships outside the village. In six percent of the activities respondents mention that those are conducted with people from both in and outside the village (Figure 78 in the Appendix).[223]

When looking specifically on water management patterns, the following figures must be mentioned: In Vietnam, less than a quarter of all respondents indicate that they synchronise field preparation, the duration of crops or water release. In Cambodia, however, 70 percent of the respondents answered that they do synchronise at least in regard to one of those activities. Overall, the synchronisation of field preparation is most common (Figure 33).[224] It seems, however, to be more stable or regular in Vietnam than in Cambodia. Of all Cambodian respondents who said they engage in collective water management activities, 53.8 percent do so occasionally only. In contrast, most of the Vietnamese who engage in such activities do so for every crop (Figure 79 in the Appendix).

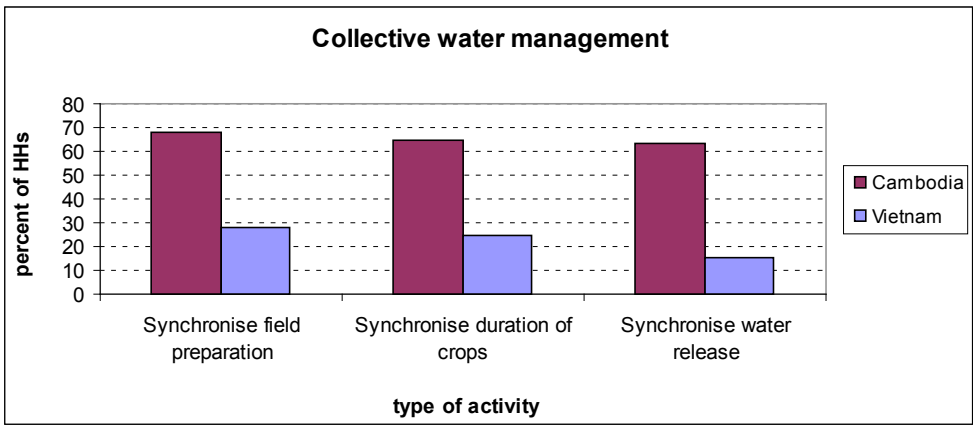

Figure 33: Synchronisation of water management by country (n=160)

Only 11 HHs (6.9 percent of all respondents) mention disputes in regard to the use of land and water - all of them being Cambodian (nine in TK and two in PE). Four HHs in TK report that disputes occurred within the family. All other disputes occur with other farmers in the same village. Forty-six percent of all water and land conflicts are rated as "moderately serious" and each 23 percent are rated as "very serious" or "not serious".

To summarise the information on collective action, only a quarter of all respondents is a member of a formal organisation. However, more than 65 percent of the sample engage in informal collective agricultural activities, mainly field preparation, transplanting and maintaining public spaces. Nevertheless, collective fishing is not mention to be conducted collectively very often. Reasons for engaging in collective activities are mainly "reciprocal labour arrangement" and "financial remuneration". It can thus be concluded, that informal collective activities play a more important role than the formal membership in any organisation. The majority of HHs cooperates with its neighbours.

[223] For Cambodia, this distribution is very much similar for all activities. No activities that are done solely within the village. However, in Vietnam, crop security/guarding, guarding fisheries/fish ponds, maintaining public spaces are all activities that are solely done with people from the own village.

[224] The low synchronisation in regard to water release in Vietnam contradicts the information about the DARD regulation. However, respondents might have anticipated that the question addresses voluntary/additional synchronisation and the percentage of HHs that synchronise water release is in fact low.

5.6 Activities related to aquaculture

Involvement in aquaculture

Overall, 46.9 percent of all HHs (75 HHs) indicate that they are or have been involved in aquaculture production during the last year. These represent 43.2 percent of the Cambodian sample and 51.4 percent of the Vietnamese HHs. Most aqua systems are grow-out culture ponds (47 percent) and stocking in flooded fields/rice cum fish systems (33.8 percent). These latter systems, representing 23 HHs, also include the Vietnamese CBFC project farmers (19 in total). Ten percent of aqua systems are nursery pond systems. Hatcheries, homestead ponds and trap ponds each only represent 2.9 percent of the aqua systems in place. Nine Vietnamese HHs indicate that they have two different aquaculture systems. Figure 34 shows the amount of aquaculture systems in place by country.

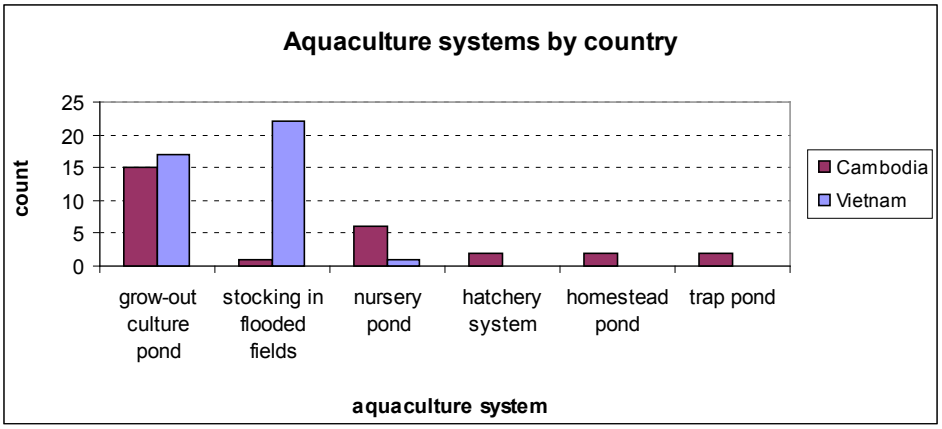

Figure 34: Importance of aquaculture systems by country

Looking at the non-project members only, nearly 21.7 percent of the farmers involved in aquaculture were practicing it for three or less years, whereby the remaining HH were involved for four to up to 26 years (mean 4.28; std. dev. 6.16). Most of the farmers that cultured less than three years had grow-out culture ponds (67.6 percent) and were Cambodians (68.6 percent). Reasons for discontinuance were not mention.[225] Main species cultured across all systems are common carp, tilapia and pangasius, while in rice-fish systems common carp, bighead and silver carp dominate (Figure 80 in the Appendix). Farmers that do not culture in rice-fish systems sell 40.9 percent (std. dev. 43.19) of their fish harvest, whereby on average 95 percent (std. dev. 16.99) of the fish harvest from rice-fish systems is sold (Figure 35). Responsible for aquaculture production are mainly the heads of the HH (54.7 percent).[226] However, also their wives/spouses (20 percent) and children (17.9 percent) engage in aquaculture. For the culture in the rice-fish systems it is slightly more HHHs (56.2 percent) and less other HH members.[227]

[225] Of the farmers that engage in the project, eight indicate they have discontinued after the first year, which represent the farmers in E2 hamlet.
[226] Of these HHHs, 77.7 percent are male HHH. This data is slightly different from the data presented about occupation. This is a further sign, that fishing and aquaculture activities must not be seen as an occupation, but maybe only as an additional activity.
[227] See Figure 81 in the Appendix.

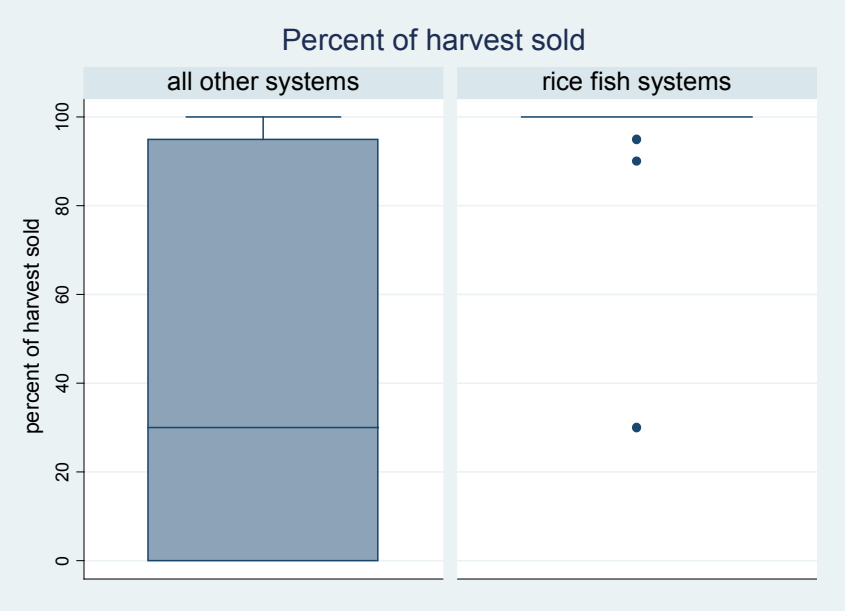

Figure 35: Box plot showing percent of harvest sold in rice-fish systems and all other aquaculture systems

Inputs for aquaculture production

The sources of aquatic seeds also differ between the systems as well as between the countries. While most of the seeds are purchased from a private hatchery or nursery in Vietnam (86.7 percent), the Cambodians rather use wild seed naturally trapped in ponds or ditches (49.4 percent) or they rely on government subsidised seeds (21 percent). In the rice-fish systems only, the percentage of seeds purchased from a local hatchery/nursery are higher (87.5 percent) in comparison to 52 percent for all systems. None of the seeds for the rice-fish systems is caught in the wild or subsidised from the government.[228]

The dry season water source for the aquaculture production is mainly pumped water from canals and rivers (28.2 percent). Also rainfall and groundwater are used, but in only in 9.4 percent of the aqua systems. Seven percent indicated that they do not produce during dry season, the others use either tube-well (5.9 percent) or gravity water from local water sources (3.5 percent). More than 40 percent of the HH involved in aquatic production indicate that they used hired labour for guarding (23.5 percent), pond excavation (21.2 percent), harvest (14.1 percent), stocking (12.9 percent), filling the pond with water (11.8 percent), feeding (9.4), selling (2 percent) and processing (1.2 percent).

[228] The fish is usually fed 5.5 times a week (std. dev. 4.66), whereby none of the farmers that culture fish in a rice-fish system indicated that they feed their fish. Feeds and fertilisers are applied by 40 percent of the HHs involved in aquaculture. These include rice bran (28.2 percent), commercial feeds (12.9 percent), cow dung (10.6 percent), pig dung (10.6 percent), kitchen waste (10.6 percent), other grain or pulse (4.7 percent), veggie waste (4.7 percent), commercial inorganic fertilisers (2.4 percent), chicken/duck drop (2.4 percent), green manure (2.4 percent) trash fish (1.2 percent).

Processing and marketing of aquatic produce

Sixty HHs indicate that they are involved in aquatic processing and/or marketing activities, which constitute 40 percent of the whole sample. The diverse market sources and their frequency of mentioning are indicated in Figure 82 in the Appendix. Wild catch by family members constitute nearly 72 percent of all sources for further processing and/or marketing activities. Almost 40 percent of the fish is not processed but sold directly. On the other site, 13.4 percent of the processed fish is not marketed but consumed by family members/friends. Forty-eight percent of the processed fish is fermented, 32.2 percent dried (with or without salt). The remaining 19.2 percent are chilled, precooked or frozen. Figure 36 gives an overview about the market places, where the fish (including non-processed) is sold. Return margins lie between 42 and 200 percent and are 105 percent on average (std. dev. 35.99). The highest returns are realised with wild catch that is sold fresh and door to door within the village with an average of 128 percent (std. dev. 39.35).

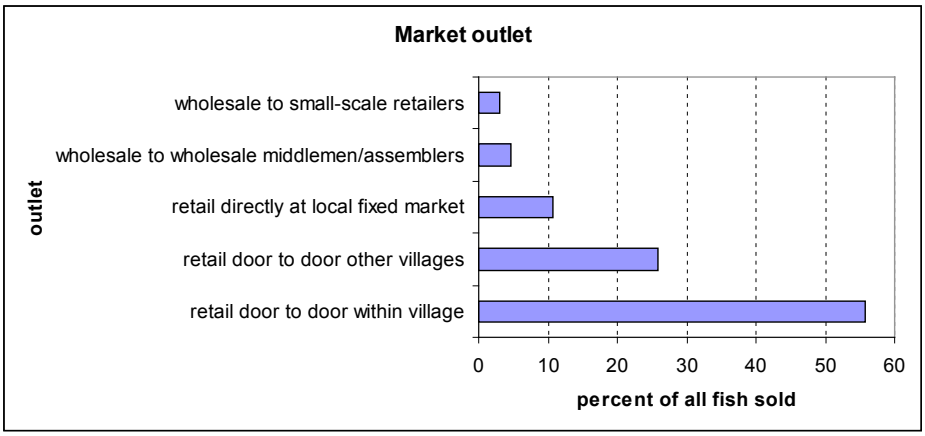

Figure 36: Market outlet of processed and non-processed fish (n=131)

Enhancement activities and living aquatic resource trends

Figure 37 gives an overview about different enhancement activities pursued by the HHs in the two countries. Enhancement activities include all measures HHs undertook in order to improve their aquaculture system. Five Cambodian HHs indicate that they did a rice and/or fish enhancement activity on their homestead in the last ten years; all of them in TK village. Four HHs explain that they have stocked juveniles on their homestead, one excavated a homestead pond. Twenty-five Vietnamese HHs indicate that they have enhanced the combined rice-fish culture, most of them in various ways. From all enhancement activities (n=65), 18 fences were installed and 18 times cultured juveniles stocked.[229]

[229] Sixty percent of the activities were mentioned to be done in TPB hamlet.

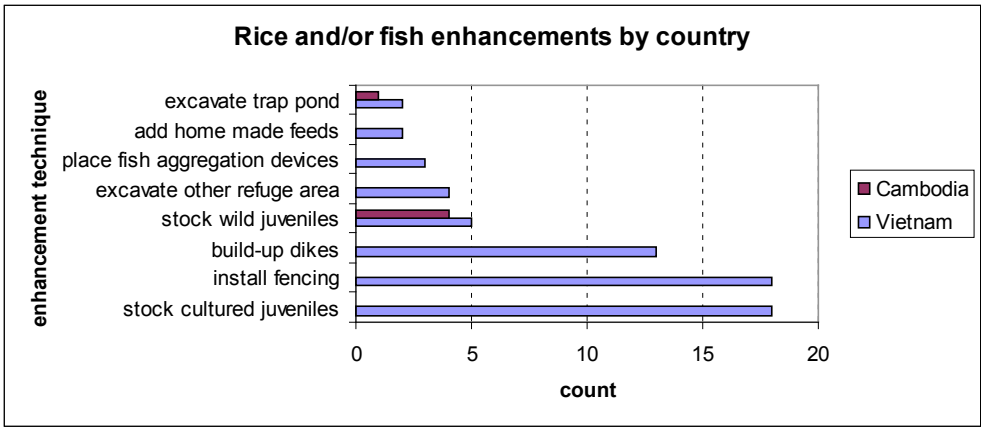

Figure 37: Enhancement activities in the last 10 years by country

Only 33.8 percent of the sample HHs indicate that they have changed their rice and/or fish cultivation practices over the last ten years. Nine percent indicate that they have changed their involvement with fish or harvesting of wild animals and plants. The reasons for the two Cambodian HHs who report a change are that 1) the fishing area was restricted and 2) the HHH is too old and sick. The remaining 12 Vietnamese HHs explain, that they rather focus on rice cultivation as it is more profitable - all these HHs are located in TPB hamlet. Here, none of the HHs involved in aquaculture production indicated that he has discontinued his involvement in aquaculture. Thirty-four percent of the respondents, with a majority of Vietnamese, report a change in their marketing and/or post-harvesting activities practise over the last years. All HHs say that the change was due to the market price and that they adjusted their activities accordingly.

In Cambodia, the survey was implemented before the project started. Here, 69.3 percent indicate they are interested in rice-fish culture in general, whereby a quarter of those would prefer doing it on an individual basis rather than collectively. In Vietnam, where the projects were implemented already, 37.7 percent of the non-project members state that are interested in the project as well. Overall, the main reasons for the preference for doing collective fish culture by non-project members in both countries are expected "benefits for the community" (35.8 percent) and "lower investments in group" (24.5 percent). Further, "income generation", the "use of free time during the wet season" and the "exchange of knowledge" were mentioned. Those who stated that they would rather do rice-fish culture on an individual level explain that they have "better access to fish" (33.3 percent) when doing it on an individual basis. Further, HHs say that that the "project site/rice fields are too far away" (13.3 percent) and that they "lack experience and guidance" (13.3 percent). The fear of having conflicts in the group is only mentioned, but only by one HH.[230]

[230] Only seven HHs stated clearly that they are not interested in rice-fish culture. The reasons are diverse, with each HH having its own reason for not being interested. These include, e.g. a "lack of money" and the "possibility of having conflicts in the group". Also mentioned are a "lack of land" and a "lack of labour", "difficulties with the infrastructure" as well as "no time due to other activities".

After the first year of fish culture, four Vietnamese project HHs, state that they are not interested in rice-fish culture anymore, whereby 14 Vietnamese HHs indicate that they still want to do rice-fish culture. Reasons for not being interested to culture fish in rice fields anymore are a "lack of money" (two HH), a "lack of land" (one HH) and the "possibility of conflicts in the group" (one HH). The two HHs that indicate they would rather do it on an individual basis state that they "fear conflicts in the group" and have "better access to fish", when doing it on an individual basis.

Thirteen Vietnamese and 16 Cambodian HHs made suggestions on how to improve the technical implementation of the rice-fish culture with only seven of them being already CBFC project farmer. Suggestions include "feeding the fish every day", "guard all the time", "have the rice field closer to the homesteads" and "introduce more fish traders/sell fish to market". Two Cambodian project farmers suggest "establish possibility to increase water supply" and "feeding every day". Fifty-six HHs (35 percent) made suggestions when asked how the organisation of rice-fish culture in their village could be improved, including 12 project farmers. The Vietnamese project farmers, who experienced the first trial already, suggest the following: "established regulation and get recognition from the local authority" (five farmers), "make a plan/improve organisation" (three farmers), "get support from the government" (two farmers), and "organise guarding properly/rotation system" (one farmer). When looking at those HHs that are not yet involved in the project, but suggested improvements in regard to the implementation of the rice-fish culture, the main answers mentioned were "establish possibility to increase water supply" (19 HHs), "have regular meetings" (11 HH), "increase cooperation" (ten HH) and "include all people" (six HH).

Forty-seven Cambodian HHs answered the question "what would they stop practicing rice-fish culture in a group?" and 29.9 percent of those indicated that there is no reason to stop. However, 25.5 percent indicate that they prefer doing it individually anyway as they then make more profit or that they do it individually as soon as they gained enough aquaculture knowledge in the group project. Over 20 percent said that they would stop if there were "problems/conflicts in the group" and 19 percent when there are "problems with profit sharing/no honesty".

Overall, differences between the rice-fish systems and other systems (e.g. grow-out culture pond, trap pond) can be observed in regard to the species cultured, the aquatic seeds, feeding, marketing and members involved. In rice-fish systems, 95 percent of the harvest is sold. Improvements of rice-fish culture were suggested by project and non-project farmers and include "fish feeding", "guarding" and better marketing options as well as "improving the organisation/making a plan" and "get legal recognition by the government". Twenty-five percent of the respondents said they would prefer doing fish culture on an individual basis. More than 20 percent indicate they would stop when there are conflicts in the group, especially when those are about profit.

5.7 Factors influencing project participation

The following section presents results from regression analyses investigating the factors that influence the likelihood to participate in the community-based project. First an analysis is done elaborating the influencing factors for becoming a project member on an individual basis. Additionally, an analysis is conducted on a HH level, investigating whether specific HH characteristics determine the likelihood of participating in the project. The following Table 11 provides summary statistics for all non-binary variables used in the probit regressions.[231]

Variable	Obs.	Mean	Std. Dev.	Min	Max
Age	560	36.066	15.208	18	95
Education (No. of years)	560	6.195	3.771	0	18
Years living in village	560	30.227	16.502	1	107
HH size	560	6.55	2.327	1	14

Table 11: Summary statistics of non-binary variables used in the probit model[232]

The regression results are presented in Table 25 and Table 26 in the Appendix. Models S1 and S2 thus show the regression results including only individual characteristics collected of HH members. Models S3 and S4 include HH characteristics whereby the dependent variable is still *project farmer*, thus still an individual level analysis is shown. Models S5 and S6 aggregate the data and show results at HH level, with the dependent variables being *project HH*. Here, the independent variables are variables that were collected on a HH level. Models S7 and S8 include further aggregated data about HH members, e.g. the average age and average years of education of the HH. Before excluding insignificant variables for each second model, a Likelihood-ratio (LR) test was performed to ensure that there is no significant improvement of the model when including those. For all second models the LR test indicates that the insignificant variables excluded are also jointly insignificant ($p>0.1$).

Looking at the overall fit (R^2 and pseudo R^2), models S1-S4 outperform models S5-S8 that use HH level data. However, Chi^2 statistics are reported and are significant at the one percent level for all models except model S5 and S6. Also, results of the Pearson's Chi^2 goodness-of-fit test as well as the Homer-Lemeshow Chi^2 (HL Chi^2) specification test[233] are reported and the large discrepancy between the Chi^2 and the number of observations as well as the p-statistics (none being significant) show that

[231] Probit regressions are used for the binary response model (project member or not). Standard maximum likelihood procedure is used.

[232] The youngest project member is 25 and it is assumed that only "adults" are relevant to become part of the project. Thus, the individual analysis includes only HH members with the age of 18 or older as including younger HH members would skew the results. After excluding HHs with missing values n=560. In the second set of model n=143 as the sample is based on the HHs (not on individuals).

[233] The HL Chi^2 specification test evaluates the goodness-of-fit by comparing the sample frequency of the dependent variable with the fitted probability within subgroups of observations, with the number of subgroups being specified by the investigator (here four subgroups). The null hypothesis is that the two are equal. Also the Pearsons' goodness-of-fit test examines the fit between predicted success and the sample frequencies. Resulting in a low Chi^2 shows that the predicted values and the sample frequencies are rather close to each other and can be interpreted as the percent of differences between the regression and the simple prediction by sample frequencies.

the difference between the predicted probabilities and the sample frequencies is quite small. Further, when looking at the sensitivity and specification measures, the models with individual data (dependent variable *project member*) seem to be better specified with higher Count R^2. This means, the high Count R^2 in models S1-S4 show that the correctly specified values lie always over 96 percent. Especially when looking at the Adj. Count R^2, models S5 and S6 do not seem to be specified correctly and both models do not have an advantage over the simple prediction according to the distribution of the dependent variable. Thus, the analysis will focus mainly on models S1 to S4 (and S7 to S8).[234]

On an individual level, the fact whether being male, married and being older positively influences the likelihood of being a project member (Table 25).[235] Also, having been involved in aquaculture before the project started and being a member in an organisation is significant at the one percent level. Excluding the insignificant variables seems to lead to a slightly better model.[236] However, also the changes in the coefficients are rather small and the significance levels do not change. Models S3 and S4 include more variables with HH related information (e.g. whether the HH possess land or if a member of the HH is engaging in remittance activities). Although the excluded insignificant variables in model S4 are also jointly insignificant (LR test: $Chi^2 = 4.34$; $p>0.1$), model S3 seems to outperform model S4 as well as it seems to be better specified than model S2 (Pseudo R^2, Adj. Count R^2 and HL Chi^2). In model S3 the same independent variables are significant as in models S1 and S2. However, of the additional variables, "credit taken" is significant. Thus, the fact whether the HH had to take a credit in the last year influences the likelihood of being a project member negatively.

When looking at the HH level regression in models S7 and S8 with the dependent variable *project HH*, having a HH member involved in aquaculture or taking part in an organisation are also significant and positively influence the likelihood of participating in the project. Also in this model, being a HH that needed to take credit in the last year is significant at the one percent level and influences the project membership negatively. This corresponds to models S1 to S4. Pond ownership is only significant at a ten percent level in models S5 and S6 and not significant in all other models. As indicated above, models S5 and S6 are not as correctly specified and pond ownership will be neglected in the presentation of the marginal effects. Also the mean age of all HH members is not significant, although age positively and significantly influenced the dependent variable in models S1 to S4.

[234] Comparing model S7 and model S8, the model S8 with the excluded insignificant variables is better specified (Count R^2, Adj. Count R^2, Pearson's Chi^2 and HL Chi^2). Also, all excluded variables are jointly insignificant (LR test: $Chi^2 = 7.81$; $p>0.1$).

[235] Using the probit model complicates the interpretation of the coefficients. The predicted logarithmic chance of being a project member increases by 0.05, if the age increases by one year. Similarly, married have a predicted logarithmic chance of being a project member that is 1.026 higher than for the none-married villagers. Thus, the analysis focuses on the presentation and interpretation of the predicted probabilities (Table 12 and Table 13).

[236] Comparison of Pearson's Chi^2, HL Chi^2, Count R^2 and Adj. Count R^2, although Pseudo R^2 is lower.

Marginal effects and changes in the predicted probability are, due to the model specification and goodness-of-fit measures, only reported for and compared between models S3 and S8.[237] Table 12 summarises the predicted probabilities for the significant variables after the probit regression in model S3. The marginal effect of age is zero, indicating that being one year older does not increase the probability of becoming a project member (column 4). However, the first column shows the change in probability due to age changing from the minimum to the maximum observed value. It indicates that the oldest person has a 54.02 percent larger probability of being a project member than the youngest person in the sample (age 18).

Variable	**min ->max**	**0 ->1**	**Marginal Effect**
Age	0.5402	0.0000	0.0000
Male	0.0005	0.0005	0.0004
Married	0.0012	0.0012	0.0008
Aquaculture producer	0.0036	0.0036	0.0005
Organisational member	0.0122	0.0122	0.0009
Credit taken	-0.0006	-0.0006	-0.0006

Table 12: Changes in probabilities for significant variables in model S3

The marginal effects of all other variables are difficult to interpret as they are all dichotomous.[238] Here, the change from 0 (failure) to 1 (success) is more interesting (column 3). The strongest effects can be seen for those who are a member of an organisation (0.012 or 1.2 percentage points) and HH members that are already involved in aquaculture production (0.0036). Being male increases the probability of being a project member by only 0.0005, being married in comparison to not being married by 0.0012 when all other variables are at their means. In contrast, being a member of a HH that needed to take a credit in the last year decreases the probability of being a project member by 0.0006. The described effects are stronger when looking at Table 13, where the changes in probability for the variables in model S8 are reported. Having a HH member in an organisation or having a HH member involved in aquaculture production does increase the probability of being a project HH by 13.48 and 38.92 percentage points respectively. Being a HH that took a credit, however, reduces the probability of being a project HH by 16.62 percentage points. Also, being landless reduces the probability of one HH member participating in the project by 12.34 percentage points.

[237] Marginal change is the partial derivative of the predicted probability or predicted rate with respect to the independent variables. Discrete change is the difference in the predicted value as one independent variable changes values while all others are held constant at specified values. The discrete and marginal change is calculated holding all other variables at their mean. The discrete change is computed when a variable changes from its minimum to its maximum (min → max) and from 0 to 1 (0 → 1).

[238] Marginal effects are inappropriate for binary independent variables. Long (1997) therefore prefers measures of discrete change. The discrete change for a change of δ in Xk (holding all other variables constant) is Pr(Y=1|X, Xk+δ) – Pr(y=1|X, Xk).

Variable	min->max	0->1	Marginal Effect
Aquaculture producer	0.3892	0.3892	0.2540
Organisational member	0.1348	0.1348	0.1731
Credit taken	-0.1662	-0.1662	-0.1903
Landless	-0.1234	-0.1234	-0.1420

Table 13: Changes in probabilities for significant variables in model S8

It can be summarised that the variables aquaculture producer, member of an organisation as well as credit are the most influential factors for participating in the project as they are significant in all presented models and as they have the strongest change in probabilities. Thus, it seems that people who are already engaged in aquaculture are also interested in participating in such a community-based aquaculture project. They might also participate because their knowledge was considered as valuable and thus they have been approached by other members inviting them to join. People that engage in other organisations seem to be interested to further increase their participation in common activities. This can be due to social reasons and people might like sharing their time within groups. However, these people might also be the ones most concerned with common or village issues and thus aim to contribute to the improvement of e.g. the living conditions in the village. The fact that HHs that had to take a credit in the last year are rather not participating is, of course, due to the fact that the financial obligations within the project would have been difficult to fulfil by these HHs. However, it is also alarming considering the project's objective of being inclusive and explicitly supporting the poor.

It is also worth examining the marginal effects of the non-significant variables. Being a committee member or having a HH member being in a committee, for example, influences the likelihood of being a project farmer positively. This corresponds to the fact that also organisational members are rather involved in such a project and might simply show that people like to engage in social networks. It is also obvious that HHs that engage in remittance are rather not participating as, on the one hand, an additional income is generated by the HH member working outside the village, on the other hand, capacities for compensating an additional work load are rather small. What is also worth noting is the fact that fishermen and landless are also rather unlikely to participate in the project. In the course of the action research, those were found to represent rather the poorer HHs in the communities. However, both fishers and landless were considered as one main stakeholder group and were expected to profit from the community-based project. This raises again the issue of inclusiveness of the project.

To summarise, the regression results presented show that being a member of an organisation and being already involved in aquaculture increases the likelihood of participation. On a HH level, the regressions revealed that being a HH that took a credit or that is landless decreases the probability of participating significantly. The CBFC project wanted to test whether such an approach to aquaculture

can be inclusive and increase food security for poor and landless HHs. However, for poor HHs it might not have been possible to afford the initial contributions required to participate. Further, landless HHs might not have been approached to become part of the project as they were not able to contribute land holdings to the project. The following section summarises the insights gained with the analysis of the socio-economic survey and draws conclusions in regard to the objectives of this research.

5.8 Summary survey data

The data provided in this section further showed how institutional arrangements on local (and national) levels influence the livelihoods of people in the research communities. In regard to land and water governance it became obvious that land is considered as private property with most HHs holding an officially granted title to their homestead and cropping lands. However, in regard to fishing the tenure patterns are more diverse and access to water resources is granted to a much larger part of the communities, even on homesteads. Thus, with the seasonal change and flooding of private lands, the access patterns change as well. This, in turn, also shows that exclusion of community members from certain parcels is legally not possible. Thus, these dynamic tenure patterns impact very much on the project implementation as also here, the exclusion of non-members from project sites is difficult to ensure and might be questionable in legal terms.

Looking at the interaction of the stakeholders, the survey data gave much better insights into collective activities than the action research and a detailed picture about common activities in the villages was derived. People in the communities are actually actively involved in collective activities on a regular basis. This leads to the conclusion that farmers are usually willing to engage in collective activities.
Also the results from the regression analysis revealed that being a member in an organisation is a factor positively influencing the likelihood of participating in the project. However, looking at the insights gained from action research, the cooperation in the villages was a major issue mentioned to be responsible for the project failure. Based on this, further investigations in regard to cooperation in the villages are necessary in order to come to conclusions in regard to the research objective three. In the following section thus a method was chosen to focus on cooperation levels and institutions that might influence those.

6 Experimental designs and findings

6.1 Introduction

Based on the findings generated with the action research and the survey, it was decided to further investigate the cooperation between community members as well as factors that might influence villagers' cooperation. Thus, three games were chosen, adapted in their designs and implemented in the research villages. Further, four control villages were chosen to investigate whether the project implementation failed in the research villages due to exceptional low cooperation levels. As concluded in the action research, the cooperation within the fish culture groups as well as cooperation within the communities seems to have negatively influenced the project implementation. On the other hand, the survey data presents, that cooperation can be high in regard to certain activities.

The first game is a *public good game* as "achievements of shared common goods" was one main motivation for engaging in collective activities, at least in the Vietnamese villages. The *common-pool resource game* was developed as all villagers usually share CPRs with livelihoods heavily depending on access to those. Additionally, both games can be related to the project implementation itself as farmers contributed to the PG (the project) and then appropriated/harvested fish from the common culture site. Besides these two games, a *trust game* was implemented. One motivation to engage in the collective work was also "strengthening social ties" which is, of course, related to trust. Further, earlier research has shown that the level of trust within a group does influence the levels of cooperation and it is assumed that a trust level correlates with successful collective action.

The following hypotheses were derived from earlier experimental research (see section 2.3.3) as well as from the research conducted within in this dissertation so far:

1) Cooperation levels in the PG and the CPR game will be low. They will be significantly higher in the control villages.
2) Cooperation levels in both games will decrease as the game proceeds.
3) All treatments (communication, monitoring and leadership) will have a positive effect on cooperation levels. However, based on project experience, the effect of communication will be low in comparison to the effect of monitoring. The effect of leadership will be highest which is due to cultural norms.
4) Trust in the research villages will be significantly lower than trust in the control villages. The project implementation showed that trust was low already and might even have decreased due to the experience with the project.
5) According to trust levels, reciprocity levels (trustworthiness) will also be low.

At the time of the game implementation, the two Cambodian case study sites (TK & PE) were in the preparation phase and had contributed money to the project already, while the two Vietnamese case study sites (E2 & TPB) had completely finalised the first trial of fish culture and harvest. Thus, the two Cambodian villages had experiences with contributing to the PG only, while the Vietnamese villages had experiences with both, the contribution to the PG as well as with the appropriation of fish from the common pond. The four non-project villages were all situated in Cambodia and were not experienced in any of the tasks in the sense that they did not participate in the project.[239] In the following section the main outcomes of each of the games will be presented for the eight villages, taking into consideration the status of project implementation and thus the experience of the villages with the tasks. Finally, regression analyses show factors influencing the cooperation of and payoffs generated by the players.

The PG and CPR game were played with 32 participants in each of the eight villages (n=256 players), whereby each 16 participants were assigned to the PG (128 in total) and 16 to the CPR game (128 in total). Four-member groups were formed by selecting different coloured papers like in a lottery. Thus, four sessions with each consisting of four players were run for both games in eight villages. Players were allowed to only participate in one of the games.

The trust game was played with 26 to 34 participants in each of the eight villages (n=246 players), whereby half of the participants were assigned to the group A (the investor or sender group) and half to group B (the trustee or responder group). The assignment to one of the groups was determined by a lottery at the beginning of the game. Participants were allowed to have participated in one of the games (CPR or PG) beforehand. However, in four of the villages, the trust games implemented in 2006 already and thus players might have played the trust game before they played the PG or CPR game a year later.[240] All games were conducted in two/three consecutive days, announced two days in advance.[241] The male and female players were selected from within all education levels and wealth categories, but needed to be above the age of 16. The target communities in Cambodia included the two Cambodian case study sites as well as four additional communities in Kampong Thom and Kampong Cham provinces. In Vietnam, the experiments were implemented in the two Vietnamese case study hamlets. A pre-test was conducted with the experiments in April 2006 that led to a comprehensive redesign in the games to make the implementation easier to understand.

[239] The analysis of the games controls for various socio-demographic data in order to ensure that the fact that all control villages are situated in Cambodia does not hinder a careful interpretation of the results.
[240] The trust games in Kampong Thom and Kampong Cham were conducted in 2006 by A. WEINGART. All other games were conducted in July 2007 (Cambodia) by the researcher and A. WEINGART. In Vietnam, all games were implemented by the researcher herself. Due to this, it was not possible to control for the influence of "experience" in playing games. Thus, the influence of the PG or the CPR game on the trust game, or the influence of these two games on the trust game is not subject to the analysis.
[241] It was ensured that all rounds of a game were implemented in one day in order to prevent players to communicate with others before those participate in the same game.

The participants were aware of the identity of the other group members and they knew each other as they were all selected within the same village.[242] In all games, decisions were always made in private, individually and kept confidential even after the games ended. The trust game lasted 30 minutes to one hour, whereby the other two games took at least two hours. The amount to be earned was aligned to the daily wages and living standards in the two countries. At this time, the daily wage was about one to 1.5 US$ for the Cambodian HHs and three to 3.5 US$ for the Vietnamese HHs. Accordingly, the players in the PG and CPR games were able to earn 10 US$ in Cambodia and 24 US$ in Vietnam, when playing social optimum all the time.[243] In the much shorter trust game, earnings were lower and players could reach a maximum of two US$ in Cambodia and 4.8 US$ in Vietnam.

Experiment instructions were presented orally in neutral terms in Khmer or in Vietnamese respectively. The facilitators in Cambodia and Vietnam remained the same for all sessions. However, the facilitator for the trust games changed as the game was implemented in four Cambodian villages in 2006 already. Players knew the number of people attending the session as well as the incentives from investing the token in the private account or in the group account. All games were arranged in a manner that reading and writing was not necessary for participation. The instructions included examples of possible actions and outcomes. However, participants were not instructed to maximise their earnings and no references to any specific strategy were made.

For the PG and CPR games only post-experiment questionnaires were used to collect basic demographic information as well as to assess the understanding of the experimental design and decision tasks. The PG and CPR games were framed according to the local situation with "contribution to a dike construction project" and "fishing in a common pond". The treatments introduced were "communication" (1), "leadership" (2) and "monitoring" (3). In the trust game, players were also assured that the game was played only once and that the experiment involved no deception. A pre-experiment questionnaire was taken to collect basic demographic information. Here, in a post-experiment survey the understanding of the experimental design and decision tasks were assessed as well as information about action motives and expectations was collected. The trust game was not framed and did not receive any additional treatment. The following section presents the designs as well as the results of each of the games. The last section compiles the findings from all games and concludes.[244]

[242] In the trust game, however, the players did not know their actual playing partner. They only knew that they are playing with one of the members of the other group (group A or group B respectively).
[243] In fact, considering the highly unlikely situation that that the player always defects while everyone fully cooperates during all rounds and the contrary, that everyone free-rides and the player herself always fully cooperates, earnings would lie between 0.65 to 42.5 US$ in Cambodia and between 1.5 to 93.75 US$ in Vietnam.
[244] In section B the Appendix provides a general instruction that was used prior to all games and the specific instructions of the PG, CPR and the trust game. This section in the Appendix also contains the (pre- and post-game) questionnaires used.

6.2 Public good game

6.2.1 Design public good game

For the PG game, a typical linear "Voluntary Contribution Mechanism" experiment (see Isaac and Walker 1988) was used, whereby players were asked to contribute to a PG – a dike construction. It was played for 20 rounds. Contributions were only announced after every round and only as group totals. After round ten as well as after round fifteen a different treatment was introduced, whereby the subjects were unaware about the amount of rounds played with each rule or about any rule change before rules were introduced. However, they were informed that the game will last about two hours. For each round, players were given an endowment of ten tokens (1,000 Riel/10,000 VND) that could be kept in a private or invested in a public account (Isaac et al. 1984).[245] Tokens kept in the private account were immediately "private property", whereby contributions to the public account yielded a return to each group member - regardless of individual contribution. This marginal per capita return was 0.5 tokens. The following Figure 38 illustrates the game as played in the villages graphically.

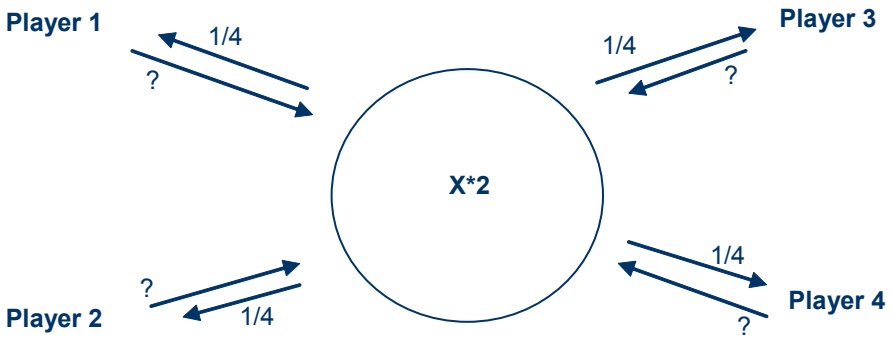

Figure 38: The PG game design

Summarising, the individual payoff function is:

$$g(x_i) = \frac{2(\sum_{j \neq i}^{n-1} x_j + x_i)}{n} + (a - x_i)$$

with player i = {1, 2, 3, 4} and players j = {1, 2, 3, 4}; x = amount of tokens; amount of players n = 4; a = initial endowment

Thus, the marginal return from contributing a token to the public account is less than the value of a token kept in the private account, but the sum of the marginal returns to the group is greater than the value of a token kept. Thereby, the individual has a dominant strategy to free-ride. This represents a social dilemma where the Nash equilibrium is formulated in a way that nobody contributes anything and where total earning would be 4 x 10 = 40 tokens. The Pareto-dominant, welfare-maximising outcome, however, is realised when everyone contributes his or her entire endowment to the public

[245] The players thus received each ten notes (10x100 Riel notes or 10x1,000 VND notes) with 1,000 Riel = 0.25 US$ and 10,000 VND = 0.66 US$.

account. This is represented when all players contribute 10 tokens and total group earnings would be 40 x 2 = 80 tokens.

After ten rounds, *communication* was introduced for the following ten rounds (treatment 1). Players were informed that they have the opportunity to communicate for four minutes before each decision. The facilitator informed the group when the four minutes were over and decisions were then made like in the first ten rounds. After another five rounds, a *leader* was chosen from the group (treatment 2). This was done with a lottery indicating the new leader with a different coloured paper. The group was then informed that communication still is possible like in the rounds before but that, after the four minutes of communication and before the decision, the leader will have the opportunity to set a rule about how much to contribute. However, like in all rounds, players were told again, that individual decisions will be made independently, in private and kept confidential. The results of the PG game are presented in the next section.

6.2.2 Results public good game

The overall cooperation level was high in the PG game with 89.6 percent of the maximum possible income reached over all 20 rounds. Both introduced treatments 1 and 2 (communication after 10 rounds, leader after 15 rounds) had a positive effect on the cooperation levels. Cooperation levels significantly increased, when *communication* was introduced from 87.2 percent to 90.9 percent (Wilcoxon signed rank: $z = -5.743$; $p<0.000$)[246]. Further, the introduction of a *leader* after round 15 had a positive significant effect on the cooperation level (Wilcoxon signed rank: $z = -3.854$; $p<0.000$) in comparison to the treatment with communication only (round 10 to 15). However, the effect was not as strong as compared to communication and non-communication. In combination, the treatments 1 and 2 led to the players reaching 93.2 percent of the maximum payoff possible. Contrary to literature, an end game effect was not observed and contributions in the last three rounds were higher than in round 15 to round 17 (Paired sample test: $t = -0.9229$; $df = 127$; $p>0.1$).[247] Thus, contributions did not decrease over time. "Leaders" themselves contributed 3.8 tokens less on average than the non-leaders. However, this difference is statistically not significant (Mann-Whitney: $z = 1.217$; $p<0.2236$). There is also no significant difference between male and female players (Mann-Whitney: $z = 0.105$; $p<0.9163$).

However, the contributions to the PG were significantly different for "experienced" and "inexperienced" villages, but only after the introduction of communication (after round 10). The

[246] The Wilcoxon signed rank is a non-parametric version of a paired sample test, whereby the difference between the two variables must not be normally distributed. It is used to test whether the median is significantly different from an expected value (here the median in the first ten rounds). The p-value indicates the significance of the difference between the values.

[247] The paired samples test compares the means of contributions in round 15 to 17 with the mean contributions in the last three rounds The tests uses the difference between the two means for each case, and tests to see if the average difference is significantly different from zero.

project villages contributed 0.8 tokens more on average in round 11 to round 20 (Mann-Whitney: z = -3.242; p<0.0012). Figure 39 presents the mean contributions over 20 rounds for the two categories "experience" and "no experience". The differences in contributions between the case study villages only are not significant and all CBFC project villages perform equally well in cooperation (Kruskal-Wallis: $chi^2 = 2.288$; df = 3; p<0.5147).[248]

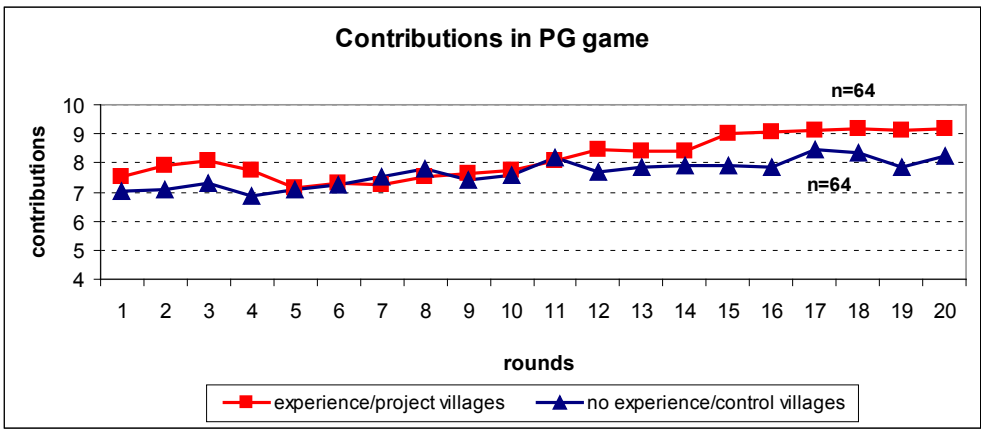

Figure 39: Mean contributions (in tokens) to the PG by project village/experience with task

Also, when looking at the payoffs only, players in the experienced villages were able to realise a higher payoff (Figure 40). However, the payoff must be interpreted cautiously as it is not necessarily a good indicator for cooperation. High payoffs can also be generated by a player who is cheating while the other group members are playing cooperative. Nevertheless, the figure represents mean payoffs generated in each round and thus they represent the payoffs of all players. They thus can also serve as an approximate measure for cooperation.

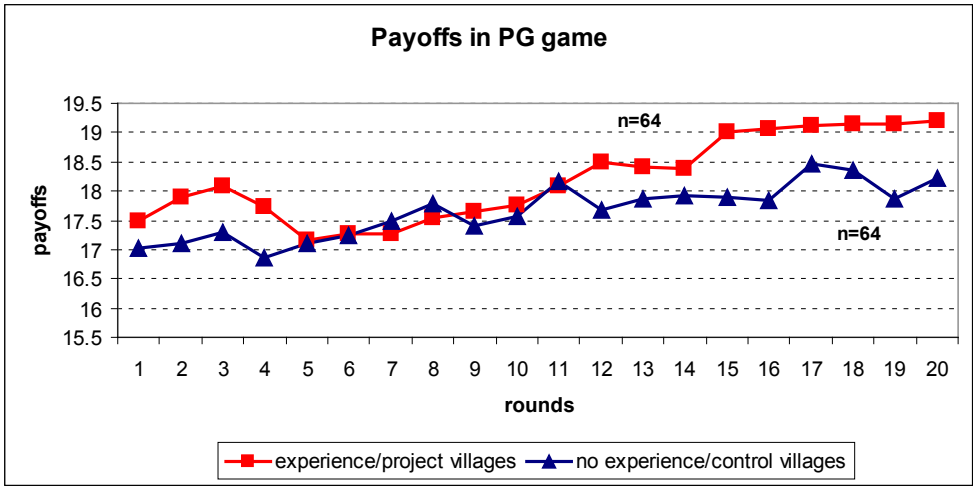

Figure 40: Mean payoffs (in tokens) in the PG game by project village/experience with task

Figure 41 shows the post-game questionnaire results in regard to understanding and the ability of relating the game to the real life. Overall, 87.5 percent of the players in the experienced villages

[248] Kruskal-Wallis test is used to test whether different independent samples differ in their mean. It can be used for the comparison of more than two groups.

indicate that they have understood the game. Also 85.9 percent of the villages with no project experience explain that they have understood the game. However, when asked about the real life similarity, only 20.3 percent of the non-project villages, but 51.6 percent of the experienced project villages answer that they can relate the game to a situation from their real life.[249] Thus, the game was general enough so that also non-project villages were able to understand the game, but the real life similarity was easier to see for the project villages.

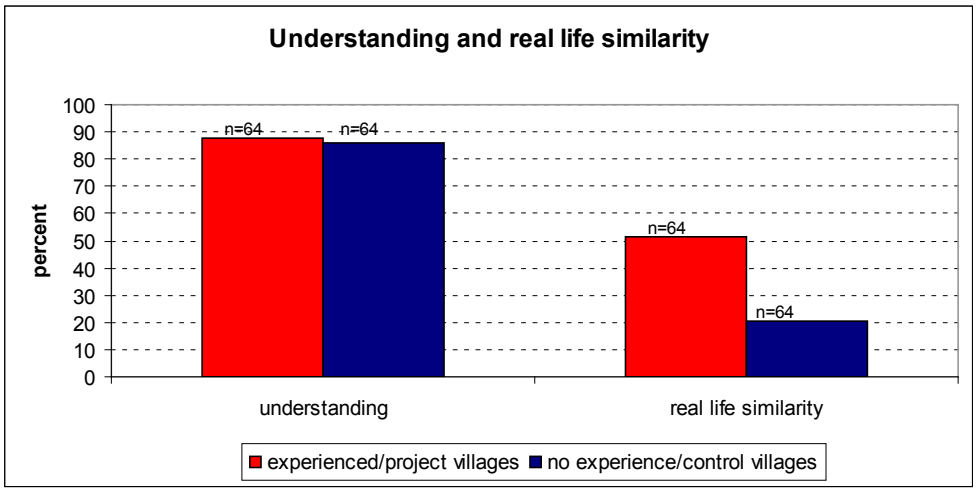

Figure 41: Understanding and real life similarity in the PG game by village and experience

The post-games questionnaires were further used to derive information on the factors influencing the cooperation levels and the payoffs generated by the players. OLS regressions were conducted to analyse the variables that influence the decisions taken.[250] Table 14 provides summary statistics of the non-binary variables derived from the post-game questionnaires and used in the regressions. These include age, education, HH size as well as the years they living in the village and the days spent for collective activities in the last year. Four data sets were excluded before the regression as for some players not all data was available. Thus, there are 124 observations used for the analysis.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Tokens played over all rounds	124	158.863	38.923	27	200
Payoff generated in total (tokens)	124	358.343	39.270	251	467.5
Age	124	43.347	13.369	18	76
Education (years of schooling)	124	4.298	3.256	0	12
HH size	124	5.663	1.850	2	12
Year. living in village	124	34.362	16.853	1	76
Days spent for collective activities	124	13.798	22.841	0	120

Table 14: Summary statistics of non-binary variables used in the PG game regressions (n=124)

[249] The low percentage of people that can relate the game to a real life situation is most probably attributed to the fact, that overall the decision situation is very much simplified and thus not found in reality.
[250] The OLS regression is used to estimate the unknown parameters in the linear regression model. Values are predicted by linear approximation using the sum of squared vertical distances between the observed responses.

Models PG1 and PG2 in the Appendix (Table 27) show the regression results with *cooperation* as the dependent variable. Models PG3 and PG4 use the *natural logarithm of cooperation* in order to minimise specification errors. Further, models PG5 and PG6 in the Appendix (Table 28) show regression results with the *payoff* generated by the players as the dependent variable. Anyway, again in order to minimise specification errors, models PG7 and PG8 show the same independent variables with using the *natural logarithm of payoff* as the dependent variable.

In all models, two or more variables are heteroskedastic and the use of robust standard errors is justified. Each second model (models PG2, PG4, PG6 and PG8) shows the coefficients and standard errors after excluding insignificant variables. Judging the overall fit of the models presented, it must be stated that the R^2 and Adj. R^2 are rather low. Further, overall, the models PG1 and PG3 with *(the natural logarithm of) cooperation* as dependent variables are not significant (Joint test all variables). However, all other models are, at least significant at the five percent level (Joint test all variables).

The Ramsey RESET test reveals that all models using *payoff* or *the natural logarithm of payoff* (PG5-PG8) as dependent variable are correctly specified. This is not true for the models with *cooperation* or *the natural logarithm of cooperation* as dependent variable (PG1-PG4). Thus it is justified to also examine the variables influencing *payoff* generated. Excluded insignificant variables in all second models (PG2, PG4, PG6 and PG8) are also jointly insignificant (Wald test).[251]

The first four models do not reveal significance of any of the variables, except the "real life application" in models PG1 and PG2. In all other models the same independent variables are significant. However, due to the heteroskedacity in models PG7 and PG8 and due to a lower R^2 and Adj. R^2 in model PG6, model PG5 is preferred and its coefficient used for further explanations. Also, model PG1 seems to be the one best specified. Thus, model PG1 and model PG5 are used for further interpretation of the coefficients.

According to the regression results, cooperation is influenced only by the ability of the player to relate to the game to his or her real life. Thus, the overall cooperation (tokens contributed) increases by 18 tokens when the player can match the game with experiences from daily life. It seems that villagers that have experienced a similar dilemma situation before are also willing to sacrifice their own payoff to overcome the dilemma.

[251] The RESET test is generally used as a specification test in OLS regressions. It can be evaluated whether the model is mis-specified, e.g. whether non-linear combinations of the explanatory variables explain the dependent variable. The parametric Wald test is used here to test for the overall significance of excluded variables.

When looking at the "experience with the task" that distinguishes the villages according to their participation in the project, it seems that those villages with experience in the project contribute fewer tokens to the PG. However, this coefficient is small and not significant. Further, it is also not negative when *the natural logarithm of cooperation* is used. Looking at the other, non-significant variables, it can be observed that being a member in an organisation does also negatively influence the cooperation level. In contrast, committee members and people that spend more time for collective action play more cooperative. Thus, it can be summarised that simply being a member in an organisation does not imply cooperative behaviour, but that taking over responsibilities as a committee member or spending much time in collective activities are better indicators for cooperative behaviour.
Nevertheless, the regressions with *cooperation* and *the natural logarithm of cooperation* do not reveal detailed insights into factors that influence cooperation. Thus, the findings are complemented with the data provided by the regressions using *payoff* and *the natural logarithm of payoff*.[252]

The years of education and the fact being a farmer or a fisher influence the payoff in the PG game positively. Farmers and fisher earned on average 27 tokens more than players that have other occupations. With an additional year of education, the total payoff raises by 1.8 tokens. In model PG5, being a committee member and engaging in voluntary collective work also influences the payoff positively, although not significantly. Also here, being an organisational member does not imply cooperative behaviour. Being a villager in one of the project villages does increase the total payoff by four tokens on average. However, this effect is also not significant.

To summarise, the regressions reveal that cooperation is significantly positively influenced by the real life application. The fact whether the village participated in the project does not influence the individual cooperation levels. However, as seen before, the collective outcomes of all players in the project villages are in fact higher than in the control villages. Thus, in regard to the hypotheses developed, it can be concluded that overall cooperation in the project villages is higher than in the control villages, and not as assumed lower. Also, the cooperation levels did not decrease with the game proceeding as stated in the hypotheses. However, the treatments 1 and 2 had a positive effect on the cooperation levels, although the effect of leadership is in fact lower than the effect of communication. In conclusion, the hypotheses must be rejected. Overall, the experience with the task or the real life application of the dilemma situation (on a village, but also an individual level) seems to be the most significant factors for cooperation in the PG game. The following section introduces the CPR game design and its results.

[252] However, one must be aware that the payoff is not a good indicator for cooperation as payoffs can also be high when the player him- or herself free-rides while all other group members play cooperatively.

6.3 Common-pool resource game

6.3.1 Design common-pool resource game

For the second experiment a CPR game (Ostrom et al. 1992; Walker and Gardner 1992) was used. It was framed as well and players were asked to appropriate fish from a common pond. After having conducted a pre-test, it became obvious, that the implementation of a CPR game representing the concave function of the payoffs for each of the player is too difficult to understand for the participants. Thus, there was a necessity to simplify the game so that also less educated players can participate. The game was therefore created in a manner disregarding the decreasing marginal return of each player, but including a dominant strategy. The CPR game was composed as follows: A pond was endowed with 40 units of fish in each round and players decided to extract units of fish to the private account or leave it to the public account. Tokens appropriated were immediately private gains, whereby fish units left in the common pond yielded a return to each group member. The following Figure 42 illustrates the game with four players graphically.

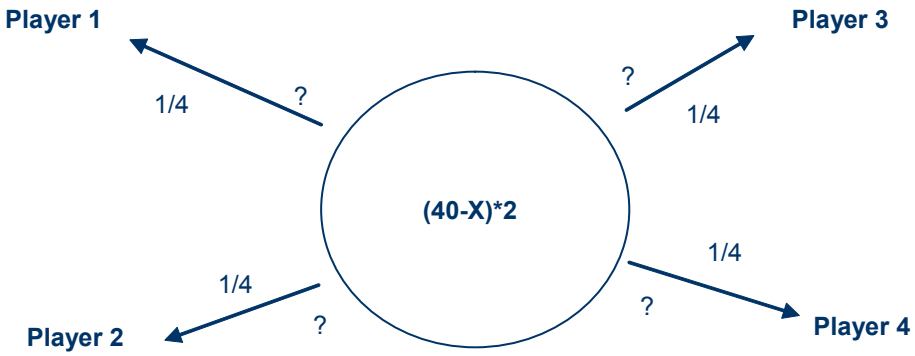

Figure 42: The CPR game design

Thus, also here, regardless of appropriation levels of individual players, each fish unit left in the pond is rewarded by the amount of 0.5 tokens. Thus the marginal per capita return is 0.5 tokens. If the total appropriation by the group is more than 40 units of fish, no player received any reward. Accordingly, the individual payoff function in the CPR game is:

$$g(x_i) = \begin{cases} \dfrac{2(40 - \sum_{j \neq i}^{n-1} x_j - x_i)}{n} + x_i, if \sum_{i=1}^{n} x_i < 40 \\ 0, if \sum_{i=1}^{n} x_i > 40 \end{cases}$$

with player i = {1, 2, 3, 4} and players j = {1, 2, 3, 4};
x = amount of tokens; amount of players n = 4

Thus, also here in the (simplified) CPR game, free-riding is the dominant strategy. Because the private reward of appropriating from the CPR is higher than reward when not appropriating, every individual has a dominant incentive to appropriate from the resource. This results, however, in the Nash-equilibrium and the inefficient use of the resource. At the social optimum, all players would not appropriate any unit and would thus all be better off.[253]

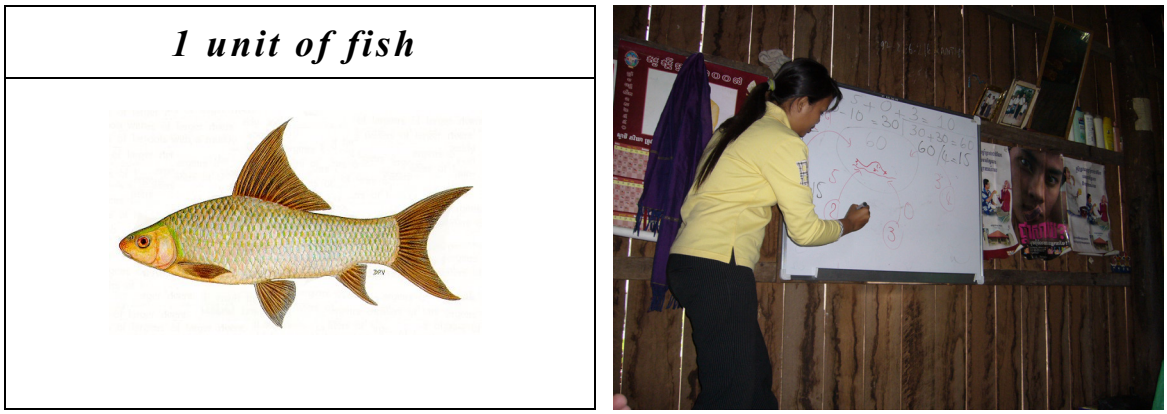

Figure 43: Game cards and facilitator explaining CPR game in Cambodia

After ten rounds, a monitoring system was introduced (treatment 3). Players were told that the new rule is to extract zero units, because "this is the best strategy for the group as a whole". After each decision and the announcement of the group total, a dice was thrown. With a probability of one to six an external monitoring of all players occurred. Every player who appropriated more than zero units from the common pond received a fine of four times the units the player appropriated.[254] These units were then subtracted from the players' total payoffs. Sanctioned players also did not receive shares from the common pond in the respective round. After 20 rounds, the end of the game was announced and players received money for each token they gained during the game.[255] The next section presents the results of the CPR game.

6.3.2 Results common-pool resource game

In the CPR game, players reached 76.2 percent of the maximum possible profit, thus less than in the PG game. This is, however, not due to the fact that in the CPR a loss of income was possible when being sanctioned during the rounds 11 to 20. When looking at the first 10 rounds only, where no treatment was introduced in none of the games, the cooperation level is 75.2 percent in the CPR game in comparison to 87.2 percent in the PG game. Nevertheless, it must be mentioned, that in the CPR game a threshold was incorporated. As soon as the groups appropriated a total higher than 40 tokens, no player received any payoff in this round. However, this happened in only 1.4 percent of all rounds

[253] In reality, zero appropriations as a social optimum are not often found. However, this point as optimal appropriation rate was used in order to again simplify the game for the participants. Further, the argument was used in regard to the project. When every group member in the group waits until the fish is harvested all together (thus appropriates zero until the harvest season), fish will be larger and thus yields the best market price.
[254] One unit extracted was punished by four units, two units by eights units of fish and so on.
[255] One unit of fish was equal to 100 Riel (0.25 US$) or 10,000 VND (0.63 US$).

(total of nine rounds). The overall cooperation was in fact higher in the PG game than in the CPR game. Nevertheless, also in the CPR game the introduced treatment 3 (*monitoring*) had a significant positive effect on the cooperation level. Players appropriated less from the CPR after *monitoring* was introduced in round 11 (Wilcoxon signed rank: $z = 7.309$; $p < 0.0000$). While mean appropriations were 4.8 tokens in the first ten rounds, they decreased to an average of 3.0 tokens in round 11 to round 20. This represents a change in payoff reached from 75.2 percent without treatment to 77.2 percent with treatment. Also here, an end game effect was not observed, when comparing the last three rounds with round 15 to round 17 (Paired sample test: $t = 0.4125$; $df = 127$; $p > 0.1$). Further, differences in cooperation between males and females are not significant (Mann-Whitney: $z = -1.175$; $p < 0.2401$).

The results about the cooperation with the treatments 1, 2 and 3 lead to the assumption that the effect of communication (treatment 1) and leadership (treatment 2) in the PG game are larger than the effect of the monitoring (treatment 3) in the CPR game. The treatments 1 and 2 led to an increase of maximum payoff reached of 3.7 and 3.3 percent. The treatment 3 only led to an increase in the maximum reached of 2 percent. However, as mentioned, in the CPR game sanctions were imposed and thus mean payoffs are lower as well. When looking at the cooperation level only (ignoring the subtraction caused by monitoring), the monitoring treatment led to a stronger increase in cooperation levels. Here, the cooperation (according to tokens played) rises from 52.4 to 69.5 percent of the maximum cooperation possible, which represents a 32.9 percent increase. With communication the change is smaller and only a 10 percent increase in cooperation is reached. Another 4.5 percent increase in cooperation is reached when the leader is introduced. Thus, when looking at cooperation levels only, the effects of the communication and leadership are not as strong as the monitoring effect.

In the CPR game the project and the control village do not correspond with the experienced and inexperienced villages. As mentioned before, two of the project villages did not finalise the whole project cycle at the time the games were implemented. Thus, they did not experience the "appropriation from the common pond" by that time. Thus, in the following, a comparison is made between project and control villages first and then the differences between experienced and inexperienced villages will be explored further. In regard to project villages and control villages there is a significant difference in the tokens appropriated from the CPR (Mann-Whitney: $z = 2.686$; $p < 0.0072$). In the project villages, player appropriate 1.06 tokens less in each round on average (Figure 44).

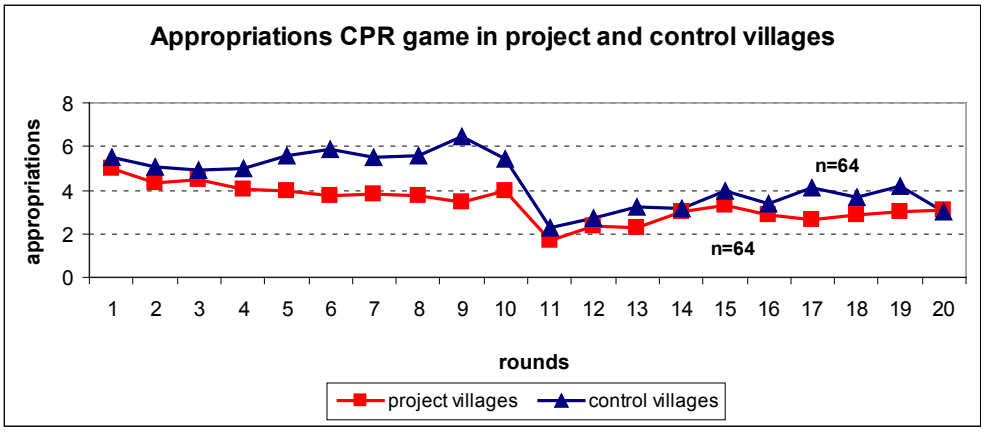

Figure 44: Mean appropriation (amount tokens) from CPR by project and control village

When comparing the villages according to their experience with the task of appropriating fish from the project pond, the difference in appropriations is even larger. Thus "experienced" and "not experienced" villages play significantly different (Mann-Whitney: z = 6.698; p<0.0000) and the experienced villages extracted 3.7 tokens less than the inexperienced villages from the CPR (Figure 45).[256] This is true for the first ten rounds without treatment as well as for the remaining rounds with monitoring. Differences in performance between the two Cambodian project villages are not significant and they perform equally well (Mann-Whitney: z = -0.678; p<0.4975). The same is true for the two "experienced" Vietnamese project villages (Mann-Whitney: z = -0.245; p<0.8064). The following Figure 45 illustrates the differences between the experienced and the non-experienced villages.

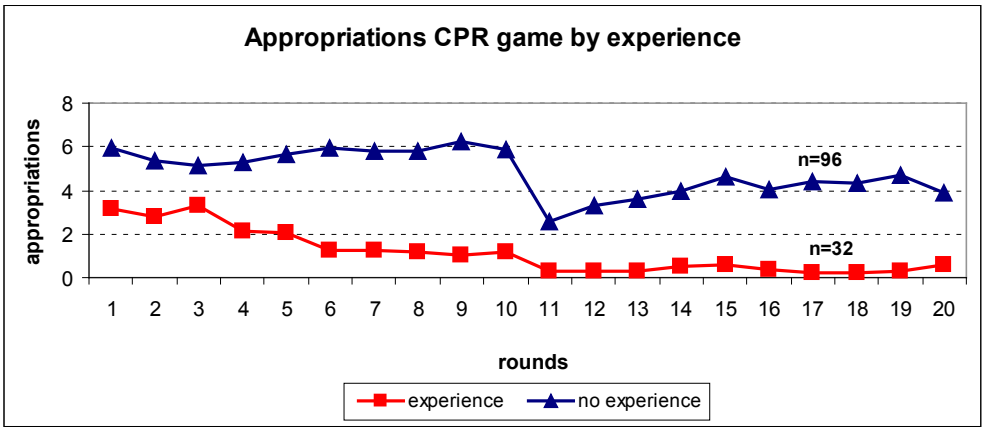

Figure 45: Mean appropriation (amount tokens) from CPR by experience with task

Also when looking at the payoffs generated by the players in each of the rounds it becomes obvious that the differences between the villages is much higher when experienced and non-experienced villages are compared than when project and control villages are considered only. The following two figures (Figure 46 and Figure 47) display the differences in payoffs for both cases graphically.

[256] Here, only the two Vietnamese villages are regarded as "experienced" villages as they had finalised the first trial of common fish culture and thus were familiar with the task of harvesting from a common pond.

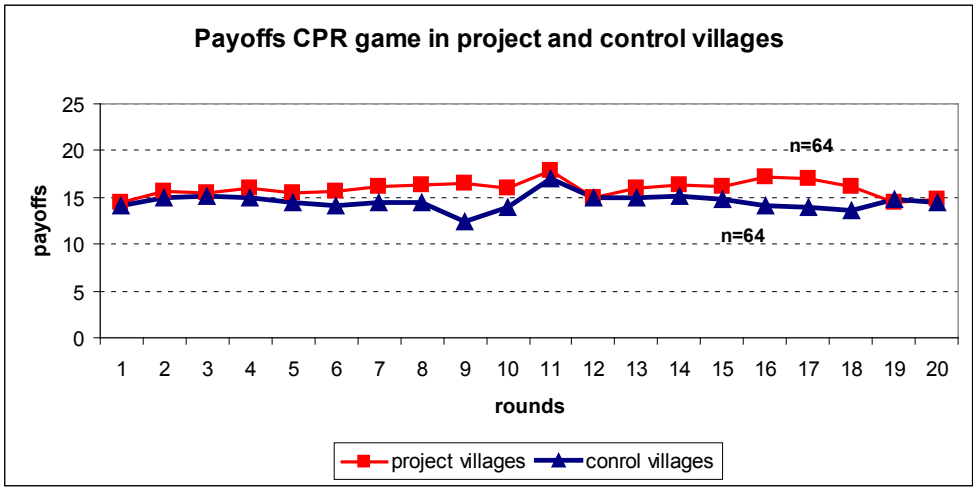

Figure 46: Mean payoffs (in tokens) generated by project and control village

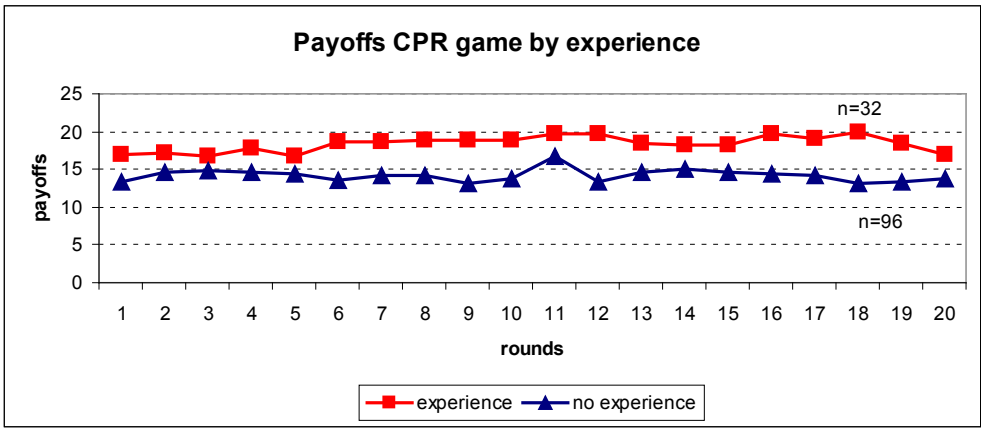

Figure 47: Mean payoffs (in tokens) generated by experience with task

A post-game questionnaire was used in the CPR game to gain information about the players, including socio-demographic data and testing for understanding (Figure 48). In the CPR game, 90.6 percent of the villagers in the two project villages that are also experienced indicate that they have understood the game. And 68.8 percent of those can relate the game to their real life. In the two project villages, where the task of appropriating from the common pond was not yet experienced within the project, 93.8 percent indicate that they have understood the game. However, only 40.6 percent are able to relate the game to a real life decision. In the four control villages, a slightly smaller percent of 79.7 percent understood the game and 37.5 percent can relate the situation to their real life. Thus, also the CPR game is general enough to be understood by villagers in non-project villages; real life similarity is, however, rather seen by the villagers that have experience with the task.

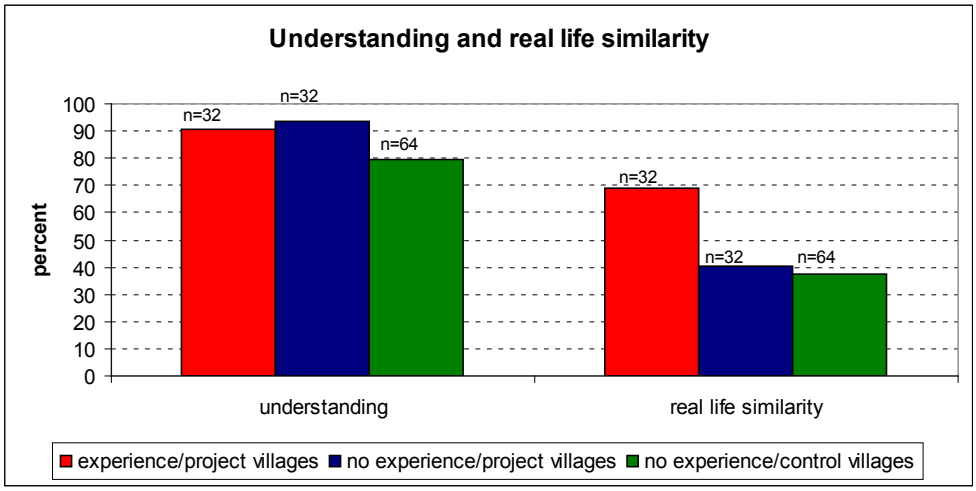

Figure 48: Understanding and real life similarity in the CPR game by village and experience

The following non-binary data was collected to be used for further regression analysis of the factors influencing the cooperation levels (Table 15). One data set had to be excluded from the analysis, thus 127 observations will be used for the regressions.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Tokens played over all rounds	127	78.063	67.519	0	333
Payoff generated in total (tokens)	127	289.177	75.935	93	423.5
Age	127	44.661	14.624	14	74
Education (years of schooling)	127	4.070	3.217	0	12
HH size	127	5.695	2.075	2	14
Years living in village	127	37.018	17.293	1	74
Days spent for collective activities	127	9.377	19.958	0	150

Table 15: Summary statistics of non-binary variables used in the CPR game regressions (n=127)

The OLS regression results for the CPR game are presented in models CPR1-CPR8 in the Table 29 and Table 30 in the Appendix. Also here, factors influencing the cooperation as well as the payoffs generated were investigated. Thus, models CPR1 to CPR4 use *cooperation* (CPR1 and CPR2) and the *natural logarithm of cooperation* (CPR3 and CPR4) as dependent variables. The models CPR5 and CPR6 use *payoff*, the models CPR7 and CPR8 use the *natural logarithm of payoff* as dependent variable in order to reduce specification errors.

All models are statistically significant and explain at least 27 percent of the variation in comparison to the prediction according to the distribution of the dependent variable. Heteroskedastic robust standard errors were used for all models. The R^2 is higher in the respective first models (CPR1, CPR3, CPR5 and CPR7) that use more explanatory variables. However, for the second models (CPR2, CPR4, CPR6 and CPR8) the Ramsey RESET tests also show that they are also correctly specified and that the

excluded variables are also jointly insignificant (Wald test). However, judging the overall fit (Adj. R^2 and S.E. of regression) the first models with more explanatory variables are preferred.[257]

Regarding the factors that influence the cooperation levels (models CPR1-CPR4), the regression shows that "experience with the task", thus the fact being a member in a project village is the most robust indicator for higher cooperation levels. Being a player from a project village positively influences the cooperation on a one percent level. Those players contributed 86 tokens more on average than the players in the other villages. Further, being male influences the cooperation in the CPR game negatively at a five percent level and male players seem to cooperate less in CPR settings. Looking at models CPR3 and CPR4 also shows that fishers seem to be more cooperative in regard to CPRs, which can be explained with the fact that they are used to appropriate fish from a common pond and are well aware of the dilemma of overfishing. In contrast to the findings from the PG game, the organisational members cooperate more than non-members. However, this effect is not significant. Also, in contrast to the PG game, committee members and players that spend much time for collective activities are rather cooperative in the CPR setting. Nevertheless, this effect is small and they contribute only 0.5 tokens less in total to the CPR.

Looking at the payoff regressions, different coefficients are significant. In all models the same variables are significant, including age, years lived in village, and the experience with the task. Being one year older reduces the payoff by 1.2 tokens on average, whereby living an additional year in the villages increases the payoff by 1.4 tokens. However, also here, most obvious is the increase in payoff, when the player lives in a village where the project was already fully implemented. Those generate a total payoff that is 102 tokens more on average than for farmers in non-project (inexperienced) villages. Also here, being a committee member or engaging in voluntary collective work increases the payoffs, although this effect is not significant. And again, like in the PG game, being a member in an organisation reduces the average total payoff. This effect is however also not significant.

In regard to the hypotheses, it must be stated that in fact, cooperation levels in the project villages are higher than in the control villages. Also contrary to the assumptions, the cooperation levels did not decrease with the game proceeding. Nevertheless, the hypothesis that the monitoring treatment will has a positive effect on cooperation can be verified. The effect was, however, higher than the effect of leadership. Thus, the second part of the hypothesis cannot be verified. Further, it can be stated that the results from the first part of the CPR analysis presented are also confirmed by the regression results.

[257] The standard error (S.E.) of the regression coefficient is a measure of the amount of sampling error in the regression coefficient.

6.4 Trust game

6.4.1 Design trust game

The trust game was designed according to BERG ET AL. (1995). In each village, the players were divided into two groups of equal size: the sender group (group A) and the responder group (group B). The sender as well as the responder each received an initial endowment (x) of four tokens.[258] Players in the sender (investor) group A could decide to keep the initial endowment or to send an amount of tokens y ($y = \{0,1,2,3,4\}$) to an unknown player in the responder (trustee) group B. The amount kept immediately turned into a private yield of player A. The amount sent was tripled by the experimenter and then given to the trustee. Player B thus had his initial endowment (x) of four tokens plus the tripled amount of tokens sent by the unknown player A (3y). Player B then decided how many tokens she or he wants to keep and if and what amount $z = \{0,1,...,16\}$ she or he wants to send back to the respective player in group A. All tokens kept, turned into private property of player B, all tokens sent immediately became private property of the respective player A. The games thus consisted of only two rounds in total with each player making one decision. The following Figure 49 illustrates the trust game procedure graphically.

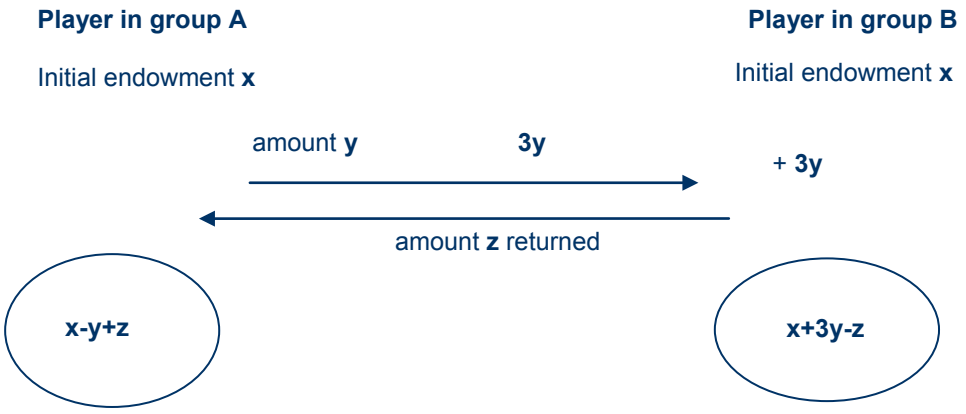

Figure 49: Trust game design

Summarising, the individual payoff function for player A and player B respectively are:

$g_a(y,z) = x - y + z$

$g_b(y,z) = x + 3y - z$ with amount sent y = {0, 1, 2, 3, 4} and the amount returned z = {0, 1, 2,…,16}; the initial endowment of x = 4

[258] This does not correspond directly to the design of BERG ET AL. (1995) as in the games presented here players in group B also received an initial endowment of four tokens. One token accounts for 100 Riel (0.25 US$) in Cambodia and 10,000 VND (0.63 US$) in Vietnam.

Players were not allowed to communicate before their decision within neither the groups nor between groups. Groups were placed into different rooms or houses during the game. A third room was reserved for the individual decision situation where each player entered, one by one, to hand over the sealed envelopes with the amount they wanted to send to player B. These envelopes were kept by the facilitators and transferred to the responders in group B in a predetermined manner that was unknown to the players themselves. The players in group B then took their decision, also in private and with sealed envelopes. All players received their money privately and in cash.

6.4.2 Results trust game

Overall, players in the trust game generated 78.8 percent of the maximum possible income. Senders earned 5.5 tokens (86.75 percent of total maximum) on average and respondents received 7.1 tokens (88.75 percent of total maximum). Table 31 and Table 32 in the Appendix present the regression models (models T1-T8) for the trust game. Also here, individual and HH characteristics as well as stated motives for sending money are contained. The first set of regressions present results for the *amount sent* (models TG1-TG4) and the second set the results for *the return ratio* (models TG5-TG8). The full models with all variables are reported as well as the model containing significant variables only. Before eliminating the insignificant variables, a joint F-test was done for those to ensure that the coefficients of the variables eliminated are jointly equal to zero.[259]

Determinants of trust

The average amount sent by the sender group (group A) was 2.3 tokens, which is 57.7 percent of the initial endowment. Thirty-five percent of the players in group A (n=123 player) decided to send their whole initial endowment. However, also 13.8 percent of the players decided not to send any money to player B. Differences in trust levels between the genders are marginal and not significant (Mann-Whitney: $z = 0.717$; $p<0.4736$). The differences of means between "project" and "non-project villages" are, however, significant at the one percent level (Mann-Whitney: $z = -7.655$; $p<0.0000$) and players in the project villages sent 2.1 token more on average. The mode is also different. The mode in the villages that are not involved in the project is one token. In the project villages, the mode is four, representing 100 percent of the initial endowment and the highest amount of trust. Figure 50 summarises the distributions of amount sent by project and non-project villages.[260]

[259] Usually, the model with more parameters will be able to fit the data at least as well as the model with less parameter. The joint F-test, however, can be used to test whether the model with more parameter also gives a significantly better fit than the one with excluded variables.

[260] Comparing the project villages only in regard to the status of implementation (fully implemented versus in process), differences in means are still significant at the one percent level (Mann-Whitney: $z = -3.656$; $p<0.0003$). However, the difference is less with the amount sent by the Vietnamese villages (fully implemented) being 3.8 tokens in contrast to 2.9 tokens for the Cambodian villages (still in the process of project implementation). The modes do not differ and are four tokens for both groups.

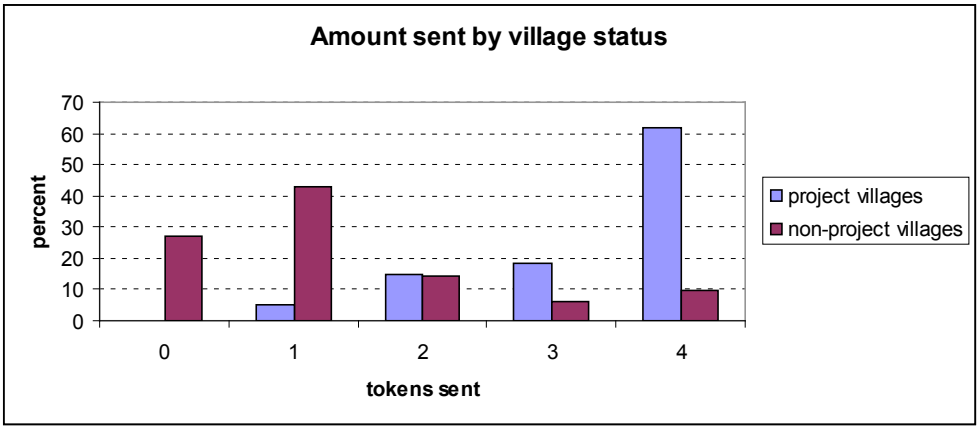

Figure 50: Distribution of amount sent by group A (n=123) by village status

When judging the overall fit (Adj. R^2 and S.E. of Regression) of the OLS regressions presented (Table 31 in the Appendix) the differences between models TG1 and TG2 are marginal, but model TG1 is preferred to model TG2.[261] Further, model TG1 and model TG2 are both correctly specified according to the Ramsey RESET test. However, to ensure the correct specification the *logarithmic function* of the dependent variable *amount sent* is used to re-estimate model TG1. This leads to a model (TG3) without specification problems. Model TG4 shows the results of the regressions with the *natural logarithm of amount sent* after the insignificant variables are excluded. The excluded variables are jointly insignificant in model TG4 only and thus it is preferred over model TG2.

The regression models TG1-TG4 show that the individual characteristics that influence the first mover decision (sender group) positively are the Motive 3 "I believe the receiver probably needs the money more than I do" and Motive 5 "I believe I will gain from sending". Both variables are significant at the one percent level. While those who belief that that the receiver needs the money sent 0.77 tokens more on average (model TG2), those who think they will gain from sending send 0.8 tokens more. Models TG3 and TG4 estimate lower effects for these. However, the significance level is still one percent.

The strongest positive effect is estimated for the project. Players in project-villages sent 1.5 tokens more on average (model TG2), which says that those players sent 47.5 percent more on average than players in non-project villages. In contrast, being a member in a committee reduces the amount of tokens sent by 1.2 token. Also in model TG3, being a committee member is significant at the one percent level, but the coefficient is lower with 0.5 tokens send less by the committee members. Also negatively correlated with amount sent at the five percent level is the belief that "I get punished after my lifetime when I am not generous". People who fear a punishment only after lifetime sent 0.59 tokens less. However, in model TG3 the coefficient is lower, but also significant at the five percent level and the players who belief they get punished for ungenerous behaviour after their death sent 0.25

[261] However, the joint F-test for excluding insignificant variables from model TG1 reveals that the excluded variables are also jointly insignificant.

tokens less. Further, the years of education influences the amount sent positively, however, this effect is small and not significant when the *logarithmic function of amount sent* is used. The next section elaborates the determinants of trustworthiness, thus the decisions of players in group B.

Determinants of trustworthiness

The average proportion returned by the respondent group (group B) is 49.69 percent (std. dev. 0.27) for the whole sample. No differences of reciprocity for male and female players can be observed (Mann-Whitney: $z = -1.558$; $p<0.1193$). Figure 51 shows the box plots of amount returned, dependent on what the player had received from player A. Clearly, those who received more also returned more and thus high investments also yielded a high return. When players B received four tokens from player A, most players B equally share and sent back eight tokens. However, also hyper-fair return ratios as well as unfair return ratios occurred (see for example all amounts less than 8 tokens in the last column of the following box plot).

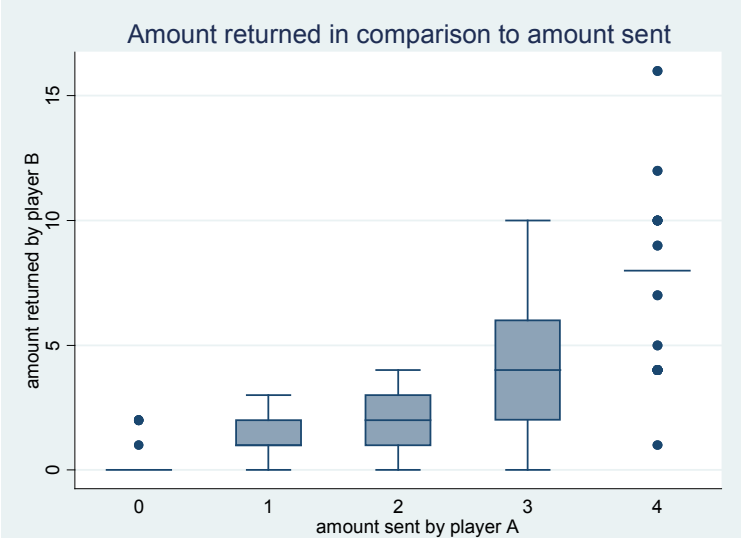

Figure 51: Box plot of amount returned by players in group B in comparison to amount received (n=123)

There are differences of the return ratio to be measured between the project and non-project villages. The players in project villages returned 57.36 percent (std. dev. 0.25), while the non-project villages only returned a portion of 39.67 percent (std. dev. 0.26).[262] This difference is statistically significant at the one percent level (Mann-Whitney: $z = -3.432$, $p<0.0006$). The mode of the return ratio is also different. The mode in the villages that are not involved in the project is 33.3 percent. In the project villages, the mode is 66.6 percent. Figure 52 summarises the distributions of return ratios by project and control villages. [263]

[262] Also the differences in means of tokens returned is significant at the one percent level (Mann-Whitney: $z = -7.199$; $p<0.00000$) and players in the project villages returned 4.55 tokens more on average.
[263] 17 players in group B did not receive any token from player A. Those are excluded from the analysis as the division by zero is not defined. However, one of those sent back one, three players send back two tokens. However, there are also some hyper-fair offers from the second mover with a return ratio above 3, but only in the

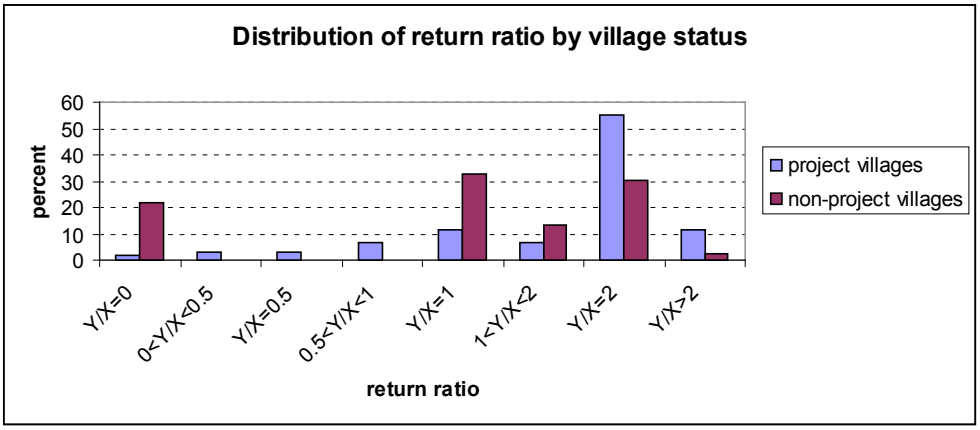

Figure 52: Distribution of return ratio of sender group by village status

A return ratio of two induces equal sharing of the investment gain, a ratio of three indicates, that the second player sent all the profit back to the first player. A return ratio of one indicates "balanced" reciprocity. Here, the first player is not better or worse off than before taking the sending decision. This was the mode for non-project villages. A return ratio below one indicates that first players were making losses from trusting their community members. A return ratio of 0 that indicates "no reciprocity" is found. This was true for 21.7 percent of the players in the non-project villages. In the project villages, a norm of reciprocating behaviour is found as players usually equally shared their gain with the first mover, so that both are better off than before.[264]

The regression results for the *return ratio* are presented in Table 32 in the Appendix. When judging the goodness-of fit for the models with *return ratio* as dependent variable, the models with the *logarithmic function of return ratio* as dependent variable have specification errors (Ramsey RESET test). Further, the R^2 and Adj. R^2 are lower in models TG7 and TG8 and the variables in model TG8 are jointly not significant. Thus, models TG5 and TG6 are preferred. These show that only the fact whether the player is from a project village does influences the amount returned. Those have a return ratio higher by 0.4 than those in villages where there was no project. Further, the offer by player A does influence the return ratio, although insignificantly. Also being male seems to influence the height of the return ratio positively, however, this effect is only significant at the ten percent level and insignificant in the models where the logarithmic function is used. Overall, the trust gamed showed that motives only influenced the decisions of player A and not those of player B. The only variable that is constantly significant in all models is whether the player comes from a project village or not. It can thus be summarised, that also for the trust game the hypotheses must be rejected. Trust levels are

project villages. Here, people wanted to "reward" the first mover for being generous. Also, in some cases, people insisted of sending money back to the first mover although they did not receive anything.

[264] Differences in the return ratio can also be observed when comparing the four project villages. The villages with a fully implemented project have a return ratio of 68.4 percent (std. dev. 0.23), the villages in the implementation phase of 46.3 percent (std. dev. 0.21). This difference is also significant at the one percent level (Mann-Whitney: $z = -3.696$; $p<0.0002$). However, the mode is similarly at 66.6 percent.

rather high and significantly higher in the project villages. Also, reciprocity is high and also here the players in the project villages are more trustworthy then in the control villages.

6.5 Summary experiments

First of all, this section showed that cooperation levels in the villages that are involved in the community-based aquaculture project are significantly higher than in the control villages. Also trust is significantly higher in the project villages than in the non-project villages. Further, all introduced treatments have a positive effect on cooperation levels. *Communication* and *leadership* increase the cooperation levels in the PG game and contributions to the PG increase with the implemented institutions. Accordingly, *monitoring in combination with sanctioning* decreases free-riding in the CPR game and less fish is appropriated from the common pond in the respective rounds with monitoring. The findings from all three experiments correspond to literature and earlier (lab) experiments. However, in the PG and CPR game a deterioration of cooperation when the game proceeds (end game effect) was not observed. Also, the introduction of external monitoring did not lead to a crowding-out of cooperation, but increased it. Differences between male and female players were not found and leaders did not contribute more in the PG game.

Also, the regression analysis revealed that being a villager in one of the project villages, influences the cooperation levels, payoffs as well as the decisions in the trust game positively. Only in the PG game, the influence of "experience with the task" is not significant, but also positive. Further, when examining the PG and CPR games, it can be shown that positive influences on the payoffs can be observed for the variables "years living in the village", "household head" and "male". Someone who spent most of his life in the village might be rather attached to his fellow villagers and thus might also play more cooperative as the game was played with these fellow villagers. HHHs are responsible for the family and might thus also behave in a more cooperative behaviour. Also, "being a committee member" and "times spent for voluntary collective activities" influences payoffs in both games positively. This supports the hypothesis, that villagers who engage in collective activities and accept a position within a committee are also rather cooperative. However, at the same time, "being a member in an organisation" influences the payoff negatively in both games. This could be explained with the argument that being a member in an organisation does not imply that the person also engages very much in collective behaviour as this also includes also non-active members. "Being a committee member" involves much more voluntary work than being an ordinary member and is an expression of real engagement. Also, the "time spent for voluntary collective work" is a better indicator for engagement in the community, than simple membership.

However, the different regression results also reveal that no general statement can be made about other factors that influence the overall cooperation levels in the PG and CPR game. Being a farmers or

fishermen increased the payoff in the PG game, but seems to reduce the payoff in the CPR game although this effect is not significant. Further, no clear statement is possible for the variables "real life application" and "understanding". This needs to be seen as positive as thus, these factors did not influence the payoffs in a manner that only players who have fully understood the game and could relate the game situation to their real life were able to realise high profits. The games were thus easy enough for everyone to understand and also villagers who were not familiar with the task could participate.

In the trust game, different factors influence the sending decisions than the decision whether to reciprocate or not. While Motives 3 and 5 dominate in the analysis of amount sent, it is rather the males who reciprocate (dependent variable *return ratio*). Motive 5 "I belief I will gain from sending" is not positively influencing the second mover decisions, which can be explained with the fact that the game ended after the second sending decision and thus for player B, there was no chance of increasing her payoff anymore. However, Motive 3 "I belief the other person needs the money more than I do", negatively influenced the sending decisions by the second mover, which does not make much sense. Also positive influencing on both trust and reciprocity are the variables "age" and being "married". Thus, older people seem to be more trusting as well as they rather reciprocate trust. The same is true for married people, which can be explained as couples trust and reciprocate in their daily life. However, the variable "being a committee member" negatively influenced both trust (significantly) and reciprocity (not significant). Also, people who were able to relate the game to their real life trusted and returned less. This can only be explained by negative experiences in real life, were trust was placed, but not reciprocated. Finally, no clear statement about the influence on trust and reciprocity at the same time can be made for a "household head", "male" and "farmer" as well as "understanding".

In summary, only the fact, whether the players belong to a project village (or have experience with the task) does clearly influence cooperation in the PG and CPR games as well as trust and reciprocity. For all other variables, it seems to be difficult to draw general conclusions. Committee members and villagers who spent more time for collective work in the community are more cooperative and reciprocate trust, when it is placed into them. However, they do not trust their fellow villagers very much. In contrast, being a member in an organisation has a negative influence on the cooperation in the PG as well as those do not sent less as first mover in the trust game and reciprocate less. Thus, membership in an organisation can hardly be used as an indicator for cooperative behaviour. This might be attributed to the fact, that often villagers are only formally members and not really involved or engaged. Collective activities are also rather pursued informally (see section 5.5). No clear statement can be made about age. While older people earn less in the PG and CPR game, they are the ones more trusting and reciprocating trust. HHHs trust less, but are more cooperative in the PG and CPR game and reciprocate more.

The following section will now focus on the conclusions that can be drawn from the research presented here. Implications will also be presented relating the findings to theory, policy as well as practice. Also, recommendations for further research will be given in this last section.

7 Conclusions and implications

7.1 Introduction

The research problem addressed by this dissertation focused on the different institutional factors that influence the success or failure of collective action for sustainable natural resource management in the Mekong area of Cambodia and Vietnam. A detailed analysis of institutions was conducted with the objective to assess and compare existing institutional arrangements and to analyse the impact of these different institutional arrangements for communal water management. Further, it was aimed at understanding the interaction of all relevant stakeholders and the impact on the adoptability of a community-based aquaculture project.

The qualitative and quantitative data analysis has shown that in both countries, the natural resources play an important role for the livelihoods of the villagers in the case study sites. Although fishing, aquaculture and other fishing related activities are not necessarily mentioned as an occupation, data has shown that those activities are an integral part of the lives in these communities (e.g. consumption of fish, involvement in aquaculture).[265] At the same time, reductions of individual catches as well as food shortages were found. Thus, the project was implemented in an area, where an increase in food security is an issue to be addressed.

Looking at the external factors, the governance system in which the CBCF project was implemented was already weak in terms of regulating access to the natural resources. Two factors in regard to property rights are of special importance in the project context: the lack of a legal basis for exclusion of external users and the lack of water flow control. With the implementation of the project a restriction of access to certain parts of the water resources was intended, but turned out not to be enforceable. Although monitoring systems were introduced, the interference by project and non-project members could not be eliminated. Sanctioning systems were not in place, probably due to the fact that a legal basis for excluding potential appropriators was not (yet) given. Respective new, more focusing, governance systems were not established, although this was intended by the implementing institutions with the support of local officials. The project relied either on a strong informal support from all community members or on support from legal entities that could have formally limit access to certain areas. In the first case, it would have been necessary that those (non-) project members respect the project implementation and the exclusion from the site during the fish culture. However, this was not the case.[266]

[265] It was also shown that it is especially the poorer HHs who are landless and engage in seasonal commercial fishing.

[266] Many of those offenders knew about the project implementation. However, hundreds of water users from different communes use the reservoirs in Cambodia and in Vietnam it is even impossible to estimate all users. Thus, it is also likely that not all stakeholders were informed about the project implementation and that some

The second possibility, recommended also by the "authority group" during the Inception workshops in Cambodia, would imply the involvement of official jurisdictions who must then establish respective community-by laws officially excluding certain water users. However, this was not followed-up on and existing legal authorities addressed in both countries were also not able or willing to solve the conflicts that occurred.

The second factor in regard to property rights that affects the project is the control over the water flow. In the Cambodian research sites, this is also a technical issue as highly developed built structures are not in place. Nevertheless, beside these technical constraints, the managerial control over the water flow is limited in Cambodia, mainly due to the fact that multiple users in several communities rely on the waters in the reservoirs and decisions on how water is distributed cannot orientate on the project necessities only. Thus, there is no possibility to adjust water levels in a manner that is necessary for the fish culture. Farmers as well as producers of aquaculture are almost exclusively dependent on rain waters. Those, however, fluctuate and add additionally vulnerability to the project implementation instead of reducing it. In both Cambodian sites, a second trial was not implemented, mainly because water levels in the reservoir did not permit the fish culture. In Vietnam, a similar difficulty can be mentioned. Although water flow to rice fields can be practically decided on an individual level, the DARD announces the time frame when fields need to be cleared from water at the end of the wet season. At this time, also the Vietnamese farmers can no longer decide about the water levels within the rice fields and thus the DARD decisions also determines the time of the fish harvest. In addition, market conditions do not create sufficient incentives. Project farmers complained about the low prices they obtained on the market, when the sold their fish at the end of the culture season. As the timeframe for fish harvest (dominated by the water release decision of the DARD) is set for the whole region or community, markets are, at this time of the year, swamped with cultured fish and thus prices decrease. A higher profit would have been realised only when storage or processing would have been possible to sell the fish later in the year. However, due to the large amount of fish and the high costs with renting storage, farmers needed to sell at a market low. The DARD regulations thus limited the entrepreneurial freedom and thus the profits realised by the farmers.

Beside the difficulties mentioned in regard to the complex property right systems, several difficulties in regard to collective action were detected. While during the games, high cooperation levels were reached in the communities, the project implementation was not satisfactory in that sense.[267] Most of

might not have been aware of the fact that they fish in a "restricted" area. Others simply ignored the fishing restriction on purpose.

[267] Solely, contributions to the public good in the games were not as high as in reality where no difficulties with the collection of the initial financial contributions to the projects were reported. This is, of course due to the fact that the decisions in the games were anonymous, whereby in the project context financial records were kept and all members were always able to see who did not contribute to the project. This social pressure led to overall satisfying initial contributions. However, also in the project context, contributions became less. Work

the project groups faced free-riding within the group and frustration about the low cooperation which led to discontinuance in at least one village. However, although free-riding certainly also occurred in the games, they reveal that the willingness to cooperate is evident. Thus, also in the project framework, cooperation itself cannot be seen as the main factor for project failure. Larger groups, missing sanctioning systems, no secure benefits (as fish could escape, die or be stolen) and ineffective monitoring due to the size of the culture sites as well as a low motivation to guard the fish are the main differences between the reality and the games. In the project it was difficult to estimate and convincingly show future benefits of the project to the participants, while in the games they have been immediate and visible.[268] Nevertheless, looking at the experimental results, it was shown that communication and leadership did increase cooperation levels significantly. In the project context, all culture groups did establish an organisational entity with one person leading the project as well as they organised regular meetings to discuss project relevant issues.[269] Omnipresent conflicts were solved on basis of discussion and conviction. Thus, it can be stated that groups themselves established the necessary institutional arrangements to coordinate their activities.

The combined evaluation of the monitoring measures implemented by the farmers in the project context and the monitoring system in the games leads to another important finding. While there was a significant increase in cooperation reached through the implementation of the monitoring rule in the game, the monitoring in the project context was ineffective. In at least three of the four sites, fish was stolen by project members and other community members during the culture period, which reduced the profits substantially. Noteworthy, in the game situation the monitoring was associated with a sanction. Still, monitoring was imperfect in the game situation (probability of 1/6), but the fear of being sanctioned reduced appropriation levels. Players lost part of their income, when being "caught while poaching". Thus, the ineffectiveness of the monitoring in the project context is probably linked to the fact that both project members and non-members did not need to fear any consequences for poaching (and other offences like destroying nets). Additionally, social sanctions (e.g. exclusion from the group) do not seem to have been imposed during project implementation. This corresponds to fact, that also fishers using illegal fishing gears were usually not sanctioned, e.g. offenders were not reported. Thus, the poaching within the project context might also be tolerated in the same sense as it is often the poor community members that usually used illegal fishing gears.

All groups expressed the need of support to prevent illegal fishing in the project sites and felt lost as they did not receive this support, although relevant institutions were approached. The ineffectiveness

---

responsibilities were not fulfilled all the time by all members as well as were financial contributions reduced (dike repairs in E2).

[268] Nature had no moves in the games and the benefit streams were thus secure in that sense. Not so in reality, where nature had a severe impact on the project outcomes.

[269] Only in TK, the organisation and leadership might be regarded as a farce only- however, the group also only constituted five members.

of the guarding, which was felt to be a high labour input, led to more free-riding and farmers reduced their individual efforts of monitoring. Consequently, this free-riding led to further frustrations in the group and project farmers themselves also started to increase their fishing efforts in the culture site again. Thus, cooperation can be described high in general terms and at the beginning of the project. But as also stated in theory, one person can spoil the game for everyone, when he free-rides. Then others will also be more likely to start to free-ride. A missing functioning system that included monitoring and sanctioning is thus identified as one main factor for conflicts that arose.

It can be stated that the project was not very much efficient with natural, technical but also important institutional challenges described to be responsible for the low efficiency. The analysis has shown that the project interventions faced severe challenges concerning property rights and collective action that in turn also influenced the sustainability of the project. This last section will draw conclusions about the research questions and the research problem posed by this research. Further, the implications of the findings for policy and practice as well as for theory will be elaborated. Also, limitations of the approach used will be discussed and suggestions for further research will be given.

The final section of this dissertation aims at providing conclusions in regard to the overall research and is structured as follows: section 7.2 provides conclusions about each research issue and 7.3 conclusions in regard to the research problem addressed by this research. Further, sections 7.4 and 7.5 provide implications for theory as well as policy and practice as derived from the conclusions about the research issues and problem. Finally, the limitations for this research will be summarised (section 7.6) and suggestions for further research will be elaborated (section 7.7).

7.2 Conclusions about the research issues

The research questions posed by this research addressed 1) the property rights system in place in regard to aquatic resources; 2) the incentives for and influence of collective action in the region and 3) the sustainability and efficiency of collectively managed rice-fish culture. The following section aims answering the research questions posed in this dissertation (see also section 1.3).

7.2.1 Property rights

The property rights systems in place were identified as strongly influencing the management of natural resources in the region as well as the project implementation. Main challenges are aligned with the unclear and overlapping rights on land and water resources as well as the low control over water levels (in Cambodia). While property rights to land are de jure and mostly de facto private and plots are individually cultivated during dry season, water resources and fishing grounds (for subsistence fishing) are characterised by an open access situation. Subsistence fishing is mainly allowed everywhere by everyone and people in the region access water resources for fishing and other purposes during the wet season. A formal regulation prohibits the use of illegal fishing gears, but

enforcement of this rule is weak. Aquaculture activities always rely on the public water and as long it is not implemented in an area, where fishing by others can be prohibited (e.g. on homestead areas) the aquaculture producers face a situation where competing claims on the resource might occur. This is especially the case, when aquaculture is introduced in larger waterbodies that are usually accessed by many users. Thus, community-based (aquaculture) projects that introduce new governance systems on local levels are always confronted with already existing formal and informal (traditional) local institutions. The implementation of new regulations can thus lead to overlapping rights and/or confusion about the regulations.

The formal coordination mechanisms in regard to water resources were found to be weak in Cambodia. It is rather informal arrangements that coordinate, e.g. the water release via sluices or the restriction of access in some parts of the reservoirs. In Vietnam, less coordination is required due to higher developed built structures and a more hierarchical, top-down regulation with formal institutions ensuring the implementation of region-wide regulations in regard to e.g. the prevention of insects. However, in both countries, illegal fishing activities, conflicts about water resources, boundary disputes and the harmful application of pesticides were reported and are an indicator that both formal and informal coordination mechanisms still lack effectiveness at least in some regards.

The vast majority of HHs in the region depends on the water resources for irrigation as well as for fishing. Fishing, aquaculture and fishing related activities are an integral part of the income generation in rural Cambodia and Vietnam. The fisheries are also especially accessed by landless, land poor and poorer HHs as they require realising an (additional) income. It must be concluded that rural fishermen as well as agricultural producer very much benefit from freely accessing the water resources. However, fish abundance in the area decreased and conflicts over water are also reported. The open access situation, albeit still providing benefits streams, also puts a severe threat on the resources and the sustainability of the fisheries might be not granted. This also strongly impacts on rural livelihoods.

7.2.2 Collective action

Collective action was required during the project implementation and project members as well as local resource users were found to face several challenges in regard to cooperation. Although formal organisations can be found in all of the villages, the membership in these organisations did not prove to be a good indicator for successful cooperation. Rather informal arrangements impact on the livelihoods of the people in the region. Cooperation is high when benefits are obvious and immediate and farmers cooperate in real life in regard to the synchronisation of field preparation or water management issues. Cooperation in regard to fishing is low and fishing is rather done on an individual basis. Cooperation is also rather limited to the family and members of the own village and is seldom conducted with members from other communities. Nevertheless, when incentives for cooperation are given, villagers in both countries engage in collective activities. However, with this research it was

shown that cooperation is often not perfect and can easily break down, when external factors influence the collective activities. It was also shown that instability of collective action can further deteriorate it. The frustration of being a victim of other's opportunism led to opportunistic behaviour of former co-operators as well.

Collective action must also be considered in combination with the property rights assigned. In the Mekong Delta the challenges for collective action are strongly related to the size of the waterbodies, the large amount and the diversity of water users and the difficulty to establish monitoring regulations. Although some formal institutions for water management are established and e.g. regulate the use of fishing gears or the introduction of aquaculture (in Vietnam), rule conformance is hard to achieve. Destructive use of the resources was observed and reported. As long as the individual benefits from non-conformance with the rule to a larger extent than he benefits from cooperative behaviour, the resources will be used in this manner. Thus, as long monitoring is not enforced and aligned with respective sanctions, the opportunistic resource use will continue and is difficult to abandon. Further impacting on successful collective action is the fact that in the wetlands of Cambodia and Vietnam thousands of users need to coordinate (e.g. over 2,000 HHs use a reservoir). The larger and more diverse the users, the harder the coordination. And although the users might be homogenous in regard to their religion, kinship, ethnicity and history, they also differ in regard to their endowments and preferences (especially in regard to resource use).

Nevertheless, reconsidering the design principles developed by OSTROM (1990), this research has shown that respective institutions can increase the cooperation of HHs in the region (see section 2.3.2). These include e.g. clearly defined boundaries, monitoring and sanctioning mechanisms, and the support from other institutions (Ostrom 1990). However, the implementation of these institutions turned out to be difficult. While, e.g. communication between water users can increase cooperation, the amount of users and the physical size of the resources the users are dealing with, complicate an effective communication. Communication platforms as such are not in place (yet) in the Mekong region. Also monitoring and sanctioning have an effect on cooperation. However, although formally established, the monitoring systems in the region are only poorly implemented and lack effectiveness. The resources are simply too large to be monitored by a single (central) agency. It is rather necessary to establish a system of multi-level governance, where different responsibilities are taken at different levels. Further, in order to make monitoring systems more effective, it is inalienable that local resources users do not only get involved but also get the power to manage the resources as CPRs. This includes assigning property rights to the communities and giving them the power to establish their own systems of monitoring with the right to sanctioning offenders themselves.

This research has also shown that it cannot be concluded that the resource users in the Mekong area are not able to engage in successful collective action. Nevertheless, it became obvious, that local users need support from higher institutional levels when collective CPR management wants to achieve sustained benefits for the communities. This support should address training needs, fostering of linkages between local level organisation as well as conflict resolution mechanisms. Local users alone might not be able to establish a formal or informal basis for securing their claims on the resources.

7.2.3 Sustainability, efficiency and equity considerations

The underlying institutional arrangements described in this research impact largely on the sustainability and efficiency of community-based aquaculture in the region and several institutional challenges restrict the benefits that can be derived from these kinds of interventions.

Although specific stakeholder groups might be willing to cooperate, fostering community-based projects in the common waters in the region is always concerned with difficult governance situations as presented in this research. The assignment of exclusive rights to water is practically not possible due to the nature of the resource. It might also socially not be desired. Thus, newly introduced governance schemes based on collective action must take local, already existing governance structures into account to avoid an overlap of "new" and "old" institutions. Also, it must be avoided that exclusion severely affects livelihoods, especially those of the poor. New governance systems will also only be sustainable when a shared understanding of the (new) rules is reached. Otherwise, confusion might exist among different user (groups) about what is permitted or desired. Additionally, rules are not self-enforcing and depend on enforcement. This research has shown that while the enforcement mechanisms in regard to other regulations were not functioning well also the community-based project was challenged by the size of the waterbody and the amount of users.

In conclusion, institutional arrangements required to achieve community-based aquaculture that provides sustained benefits for all stakeholders concern an increased cooperation between water users, enforcement mechanisms (including the recognition of the newly established institutions) as well as support from higher level institutions. The project planning, implementation and evaluation must thus embrace not only the direct stakeholders, but also all other users that the project might impact on. This includes, e.g. the information of water users about an access restriction in certain areas, but also the establishment of rules that are acceptable for those indirect users. Nevertheless, as rules are never self-enforcing, stakeholders must come to an agreement about enforcement mechanisms of the rules. Otherwise, benefits might diminish due to opportunistic behaviour of just a few, which will threaten overall cooperation and thus the efficiency of the project. Further, to increase the acceptance in the wider community and surrounding communities, inclusion measures might be needed that compensate for any restrictions posed on other users. This could, e.g. be reached by employing landless farmers that cannot directly participate in the project for certain duties (e.g. guarding) and proved successful in other WorldFish projects (see e.g. Bangladesh).

7.3 Conclusions about the research problem and objectives

The aim of this research was to understand the different institutional factors that influence the success and failure of collective action for community-based aquaculture in the Mekong Delta. The main factors influencing the success of collective action are summarised as 1) the characteristics of the natural resources in the Delta; 2) the governance mechanisms in place in regard to water management and 3) the (amount of) resource users. The first two factors are exogenous variables as defined in the IAD, namely the biophysical conditions and the rules. The third factor concerns the participants of the action situation. Thus, beside natural and technical challenges, three main factors were identified that influence collective action for community-based aquaculture.

Collective aquaculture in the region depends on the use of public waters. Water as a CPR is, e.g. other than land, characterised by special features that increase the difficulty of sustainable management. Water is fluid and moves across boundaries. In the Mekong Delta, vast areas of land are covered with waters during the wet season. Often whole districts or extremely large reservoirs are covered with waters. Boundaries are not defined or change seasonally. And users from different communities access these waters for different purposes. This makes collective action difficult in the sense that a) communication between water users is limited and that b) monitoring is extremely difficult. Thus, the physical sizes as well as the "fluid" character of the waters are seen as main limiting factors for collective action in the communities.[270]

Obviously, these characteristics impact on the governance of the resources. First of all, a distinguishing feature of the region is the dynamics in property rights - the change with the season. The water resources are regarded as a common good, but characterised by open access. The exclusion of users is (practically) not possible and it is used by individuals for their purpose irrespective of the outcomes for the collective. However, conflicts over water, a reduction of fish abundance and a decrease in individual catches show that the water resources are in no case infinite. Governance mechanisms fail to regulate the individuals' resource use, even when those might hurt the rights of the collective or the sustainability of the resource. Monitoring and sanctioning systems are not working well. For now, open access provides secure access to benefit streams to many community members. However, the dilemma will increase as soon as the fish stock (and other natural resources) are further reduced and threatened to diminish. The sustainability of the open access resources and with it the sustainability of benefit streams is highly questionable.

To improve the management of the resources towards more sustainability granting also equity, collective action is necessary. An inclusion of all stakeholders is inevitable necessary in order to

[270] Also, the fact that it is impossible to estimate the amount of fish in the waters further complicates the situation.

coordinate individuals' activities and overcome the common dilemma. This is, however, another main limiting factor for the success of collective action in water management in the region. While cooperation among resource users in the Delta is possible when respective conditions are given, the main challenge for collective action is the large number of (diverse) users in the region. Communication and enforcement possibilities of collective arrangements can increase cooperation. However, both these arrangements are also more difficult to achieve due to size problems. The larger the amount of water users, the area and the group to be monitored, the more costs for communication and monitoring increase.

While the research has shown that the willingness to achieve common benefits and to cooperate are good, with high trust, a shared culture and ethnicity, the perquisites to expand this successful cooperation to larger groups need to be seen as limited. The implementation of sustainable community-based aquaculture, as it was investigated with this research, is challenged by many institutional factors and will require much effort to overcome those challenges.

7.4 Implications for theory building

The importance of the institutional arrangements in the context of an external project intervention was shown by this research. The significance of institutional analysis was thereby reinforced. While, in particular for irrigation and aquaculture systems, also technical considerations and natural incidents influenced the project implementation, the institutional factors strongly impacted not only the actions of participants involved, but also the outcomes of project activities. Thus, the assumption made by NIE, that institutions govern the economic performance proved to be true.

This research has also shown that the underlying institutional arrangements, the "[…] prescriptions that humans use to organise all forms of repetitive and structured actions" (Ostrom 2005b, 3), are diverse and complex, often invisible as well as differing on various levels. The IAD was used to analyse the institutional arrangements underlying the project context and it proved to be auxiliary for structuring the complex process of analysis. The analysis focused on the exogenous factors (biophysical/material conditions, attributes of the community and rules) as well as it focused specifically on the action arena itself, where different participants found themselves in the same action situation. Using the IAD, it was shown that the rules did not fit into the socio-economic and socio-ecological context and that, due to this, the community-based introduction of the otherwise promising approach did fail. Thus, theory must consider that human actions are taken in a certain nested socio-ecological context that differs from place to place and that the actions also change with time. This also leads to the conclusion that theory must abandon panaceas and accept the diversity and complexity in which decisions are taken. It is important to find out what really impacts on a certain action situation in a particular place at a particular time.

One aspect found by many other scholars could not be proved within this research. The external sanctions introduced in the CPR game did not lead to a crowding-out of cooperation, instead they improved cooperation. Looking at the real world, the communities were also overcharged with establishing their own monitoring and sanctioning systems and it was even requested by farmers themselves that external jurisdictions take responsibilities for the enforcement of rules (e.g. poaching). Thus, theory must consider that in some situations local institutions rely on higher level jurisdictions for support and that self-governance might sometimes overburden collective structures when they are only recently established or when resources are too large to be managed by local communities. It is thus necessary to further investigate multi-level governance systems.

The presented research has also shown that experimental studies are important for getting a better understanding of action situations themselves. The tools for analysing these strategic interdependences offered by Game theory are essential for understanding the impacts of institutional arrangements on the outcomes derived. The control of the environment in the games was necessary in order to be able to observe regularities and to come to more general statements about cooperation. It was clearly shown that the institutions introduced had an effect on cooperation levels and that, as long as outcomes are clear and understandable for everyone, high cooperation levels as well as trust and reciprocity are possible. The experiments reinforced findings from other scholars that showed neo-classical predictions not to be solid. One main difference in regard to the results of other experiments must be mentioned. The repetition did not lead to a decrease in cooperation, but rather increased the cooperation. End game effects were not found. In further experiments, more emphasis should thus be placed on evaluating the reasons for the decrease in cooperation or the differences between lab and field experiments.

The games have shown some of the solutions for the common dilemma in this field context. At the same time, it must be stated that the experimental studies alone would not have been sufficient to answer the research questions posed by this research. Other variables that structure the action situations were not taken into account and e.g. nature had no moves in the games. However, in most situations in the real world, actors do not possess perfect information and nature does move. Thus, findings are only relevant to the reality to some extent. When Game theory aims at giving precise information about how people would act in a certain situation it must take the exogenous factors that influence the action situation into account. Thus, experimental economics must consider designing games that depict the reality as accurate as possible, including other influencing factors that also move people in their real world. Especially field experiments, with rather non-artificial tasks and players that are used to the decisions situation, should be conducted in order to depict reality much better. This will increase the external validity of experimental studies with also the subject pool becoming larger and

more diverse. There are, also in the lab, social interactions as people come into the game situation with their own history and perceptions about other people. Thus, also lab experiments cannot fade out these factors. In better designed (field) experiments these factors could be accommodated instead of pretending they are not there. This could lead to an advance in theory.[271] In this research context here, people clearly knew each other and shared many aspects of daily life. However, this was also relevant for the project implementation and thus important that the games incorporated these facts. Also, disregarding the history of the participants in games will lead to skewed results. CARDÉNAS (2000; 2003) finds that those familiar with CPR management also played more cooperative, at least with the communication treatment. The same was found in this research, where experience with a task does increase cooperation levels.

Another important implication that can be derived from the findings presented here is that the cooperation between the disciplines and the combination of different methods are of essential importance when doing research in socio-ecological systems. Many technical and natural factors influenced the outcomes of the project beside the underlying institutional arrangements. Thus, it was necessary to also understand limiting factors that are detected by other disciplines. An institutional analysis is only possible when all factors influencing the local situation are recognised and the complexity appreciated. A mixed method approach helps identifying those influencing factors from different angles.

7.5 Implications for policy and practice

This research has clearly shown that "institutions matter". The introduction of innovations need to address not only technological, but also the socio-economic, historical and political dimensions such as community structures with its collective action, property rights and tenure systems as well as existing resource uses, the views of different interest groups and power relations and their influence on governance systems. This includes a wide range of local institutions with some that have evolved over centuries. It is recommended, that practitioners consider the ways by which different stakeholders use the resources and what rules grant and restrict access to the resources. Institutions evolve and change with time and thus also with the project implementation. Throughout the whole process of project implementation an analysis of institutional structures and their impacts is necessary.

The Cambodian as well as the Vietnamese government aim to further decentralise natural resource management to lower jurisdictional levels in order to provide more effective and sustainable governance. In Cambodia, several initiatives are under way, including the establishment of local management committees like water user groups. In Vietnam, titles to land are already granted.

[271] However, there are also costs for adding complexity to an experiment. Each additional feature must be explained to the players and creates potential for being misunderstood. In turn, this can translate to additional variance (ROTH 1995).

Nevertheless, this research has shown how difficult the inclusion of all stakeholders is in a context, where large natural resources are used by many communities, and property rights change with the season. Assigning individual (use) rights to water resources is not practically realisable as water is fluid and crosses boundaries. On the other hand, as long as the water resources are open access, overfishing, the use of destruction fishing gears and the harm to the natural resources through improper management will not diminish. Thus, it is important, that coordination mechanisms with the respective governance schemes are implemented. This will also include giving real institutional power to local entities who also take the responsibilities for monitoring and sanctioning mechanisms.

The provision of secure and enforceable property rights is particularly critical to groups whose livelihood and health are especially dependent on the goods. Insecurity often results in overexploitation and degradation of natural resources, while secure property rights, can create incentives to build assets and to invest in sustainable resource management for the future. The implementation of the country-wide land titling is certainly an important step for farmers in Cambodia. However, it is also important to rethink whether private ownership on land is the best solution for lands lying in the reservoirs for example. It should be certainly considered whether the assignment of common property to user groups in the Mekong Delta in both countries might be a better solution in regard to resource management. When systems of governance for CPRs can be established, local users can also decide commonly whether these kinds of projects are a way of improving access to fisheries for the whole community.

Nevertheless, local user groups must have support from other jurisdictional levels - an overload of responsibilities and financial pressure must be avoided. Local user groups must be embedded in a system of nested institutions in order to learn how to govern the local resources and to establish financial systems that are sustainable. Second, due to the complex natural environment the rural communities live in, it is necessary to coordinate different laws and institutions that are concerned with water, fishing and land (as well as forests). Different laws apply within these sectors and sometimes overlapping rights over the resources can be found. A clear coordination of these laws must be envisaged. Third, as with different laws also different jurisdictions are holding responsibilities for the management, it is necessary to establish coordination mechanisms that incorporate all responsible jurisdictions. It will not be sufficient to establish water user groups and fisheries communities and coordinate those over community boundaries, but it is also required to also establish cooperation between e.g. water user groups and fishing communities. This all will only be possible if a system of multi-level governance is established with respective responsibilities and rights. According to the principle of subsidiarity, the levels most adequate must take over the responsibilities it can fulfil and at the same time, rights (e.g. to sanction offenders) must be assigned to the level that can most effectively make use of the right. This all presents a real challenge to the governments, regional and provincial

entities as well as to local user groups and will require a long-time horizon and efforts to realise such a holistic natural resource management approach.

Benefits from individual fish culture, which could bring the same benefits in terms of food security, cannot be compared with the benefits a community-based approach could bring. First of all, much lower yields can be realised in homestead ponds that are, due to their nature, much smaller and provide less natural feeds to the fish. In turn, fencing-up individual plots it is much more expensive and not practicable in areas where a high land fragmentation can be found. Thus, there is no justification to not elaborate community-based fish culture further and consider it as a possible opportunity to reduce poverty in rural areas of Cambodia and Vietnam. When promoting community-based aquaculture, the Cambodian government must, however, invest in building suitable technical structures also on local levels in order to improve access to waters for farming, fishing and all other HH activities. As it is expected that the fish stock further decreases, the investment in more suitable built structures will be of special importance for the region anyway.

In Vietnam, the conditions for fish culture in terms of water flow control are much better as water levels can easily adjusted to the project needs. However, with the objective of establishing aquaculture within the Mekong Delta (as e.g. explained in the “masterplan” in Vietnam), new challenges emerge. While the culture of aquatic produces is encouraged by different authorities and development agencies, it interferes with other domains, like rice cropping and access to fishing grounds in public waters. While it is important to hinder e.g. insects to spread in the rice crops, times of water release must be coordinated. On the other hand, this decreased the attractiveness of fish culture as prices obtained at the time of water release are low and investments do not yield the return they could, if time of marketing could be chosen independently of the water release. Here, clear governance mechanisms are also not in place yet. A better coordination of agriculture departments and aquaculture entities is thus suggested by this research. Further, the government focuses very much on the industrial production of fish to be cultured for export to e.g. Europe. This was, however, never the attempt of the project as it focuses on subsistence farmers that were expected to increase the food security and HH income. It is important that the government continues to support these small-scale initiatives, which are designed to be implemented in accordance with sustainable natural resource use. Also, with these initiatives, especially poor HHs can be addressed.

The promotion of aquaculture in the Mekong Basin should take food security and poverty alleviation as a starting point for interventions. It should identify and overcome constraints to entering aquaculture by building capacity of local users. Integrating aquaculture into fisheries projects and wider rural development strategies would produce a more balanced approach. Aquaculture, capture fisheries and reservoir management should be considered as a holistic system. This however, also

includes a rethinking by the implementing institutions and the involved actors. Especially in countries like Cambodia and Vietnam, participatory approaches are rather new concepts with implementing agents in the field not being trained well enough in participatory project implementation as well as they often never experienced participation themselves due to the hierarchical structures in e.g. their own work place. A bottom-up project implementation and collaborative participation must be fostered with the implementing agency only fulfilling a consultative role. An extensive preparation period, strong field presence of all involved agencies, long-term support and a holistic approach are required to support communities when implementing projects of this scale. It is also necessary to keep in mind that development projects in the absence of a supportive institutional framework can reinforce command and control structures that do not necessarily favour the poor. And it must be considered that institutional changes require a long-term perspective as changes in institutional structures also needs changes in beliefs and habits that cannot be easily introduced by outsiders. Institutional change that is supposed to be successful must be fostered by insiders.

7.6 Limitations

Overall, the research aims of this research were reached. Existing institutional arrangements for water and living aquatic resource management in the Mekong area of Cambodia and Vietnam were assessed and compared between the sites (objective 1). The analysis also captured the dynamics of these institutional arrangements in changing natural and socio-economic environments (objective 2) as well as were the impacts of different institutional arrangements for communal water management in the Mekong area of Cambodia and Vietnam assessed (objective 3). Statements were made about the adoptability of a collectively managed semi-intensive rice-fish aquaculture production technology and its sustainability, whereby the interactions of all relevant stakeholders were assessed (objective 4).

It must be acknowledged, that the generalisation of the findings presented here is disputable as a case study approach was chosen. However, the objective was mainly to understand the underlying institutional arrangements in the project villages and thus it was first of all aimed to understand the specific conditions in each of the sites. The approach proved to generate the coherence necessary for understanding the project context. However, transferring statements about the reasons for failure and success of a similar project as well as institutional structures in other communities or countries is only possible to some extent. To provide a broader comparison and to evaluate the generality of hypothesised relationships some quantitative analysis was used. This certainly increased the external validity of the research. Due to the scope of the data collected from a large part of the population in the communities, extensive data was presented. Nevertheless, some issues that might also would have contributed to the research needed to be neglected. This concerns, for example, inner-HH equity measures or the (harmful) use of pesticides in the waters. The experimental results are of invaluable usefulness for answering the research questions posed by this research. On the one hand, the reduced

complexity in the games contributed to a better comparison between the sites and other control sites. On the other hand, due to the reduced complexity the data restricts the possibility to transfer the gained understanding to the much more complex local situation during project implementation. However, not only because the objective was to focus on specific decisions led to simplified games, but also the fact that games had to be easy understandable for local villagers that are often not well educated and certainly not used to participate in these kind of research. Field experiments are always more difficult to conduct than lab experiments, where subjects and the environment are much easier controlled. Further, there is a "framing effect" caused by the game (on purpose) that creates a specific situation for the players and thus again, influencing the external validity. This limits, to some extent, the comparison of the experimental results with experimental findings from other scholars and in other parts of the world.

Overall, the approach used in this dissertation to address the research questions was appropriate. Nevertheless, it must be mentioned that an understanding of the institutional structures that govern daily life in the communities is always to some extend limited. Most institutions are invisible and they are certainly deeply rooted in history and culture. Thus, researchers will always only be able to provide an outside perspective, bringing her own culture and concepts into the field as she is socialised in her own society and can never share the history that villagers share. This also means that replication of the same research by other scholars can results in different findings as they also bring their own history into the research and thus might interpret findings differently.

7.7 Further research

This dissertation provided research findings from field research in the Mekong area of Cambodia and Vietnam. This last section now provides suggestions for further research in the region and on institutional arrangements in complex water management systems.

First of all, in Cambodia the data base in regard to natural resources and use rights on land and water is still weak. In the course of the implementation of the new land law and the country-wide land titling this weakness will be partly eliminated and data of higher quality and in higher quantity will become available. However, in Cambodia and Vietnam, it is important to further enhance research about CPRs and the advantages or disadvantages common management of natural resources in the region can bring. A large emphasis is placed on generating private ownership on land, which certainly has its warranty. However, private and state property might not be the best solution to solve the difficulties aligned to the open access situations found in most parts of the Mekong Delta. The main concern is rather how waters being characterised as open access systems can be transformed to CPRs, where local users can establish their own governance systems by holding the property rights to the resources. It is suggested to conduct further research on alternative governance systems that incorporate the

unique nature of the natural resources in the region, with an emphasis on systems that guarantee a long-term sustainability of the natural resource base.
One main constraint identified during this research was the open access to natural resources with missing monitoring and sanctioning systems. This does not only concern illegal fishing practices, but also the use of pesticides and other threats that are put on the natural resources. Local users have little possibilities to protect their investments on land or on water due to weak governance systems. Thus, it is suggested that further research in the region concerning the users' behaviour in regard to different monitoring and sanctioning regulations is conducted. Due to the scope of the natural resources in the region, alternative forms for monitoring and sanctioning should be evaluated with also elaborating whether systems can be established that give resource users themselves the possibility to sanction offending behaviour. This definitely includes further research on collective action (and the interplay of collective action with property rights), identifying the incentives of local villagers to engage in collective activities.

Further experimental research in the villages and the region should test more hypotheses and aim at even better incorporating the local situation. The possibilities to do this are numerous and depend again on the specific question that the research wants to answer. However, this could, for example, include other group sizes as in reality large user groups are coordinating their activities. It is likely that cooperation will be less, when groups are larger. Also the trust game could be played with members from other surrounding communities in order to evaluate whether trust is only to be found in the entity of a village or whether it diminishes when village boundaries are crossed. Farmers also differ in regard to their positions and initial endowments when they enter the action situation. This could also be depicted in games by endowing the players with different amounts of tokens. Also, to depict the role of the external agencies, game design could incorporate the choice of players whether they would prefer having their own monitoring system (which could be costly) or an external agent to take over the monitoring and sanctioning activities (which could also be costly). Finally, and very much important, nature should be incorporated in the games as the moves nature does in the Mekong Delta strongly influence people's decisions in regard to income-generating activities and thus also in regard to cooperation. This would add more of the real world uncertainty to the game situation.

Finally, the data base about fish resources in the region with its economic relevance for local Cambodians and Vietnamese must be improved. There is still little knowledge about the threats that are posed to the natural fish stock by several developments, including population pressure, large development projects (e.g. dams for electricity generation) and the increasing use of illegal fishing practices. As long as the importance of fish for the livelihoods of the people in the region is not properly assessed, it is unlikely that respective measures can be taken to prevent livelihoods of a large part of the population being at risk due to the developments described.

References

Aggarwal, V. K. and C. Dupont (1999). "Goods, Games, and Institutions." International Political Science Review **20**(4): 393-409.

Agrawal, A. (1999). Greener pastures: politics, markets, and community among a migrant pastoral people. Durham, NC, Duke University Press.

Agrawal, A. (2001). "Common Property Institutions and Sustainable Governance of Resources." World Development **29**(10): 1649-1672.

Agrawal, A. and E. Ostrom (1999). Collective Action, Property Rights, and Devolution of Forest and Protected Area Management. Collective Action, Property Rights, and Devolution of Forest and Protected Area Management, Puerto Azul, The Philippines, German Foundation for International Development.

Ahmed, M. and M. Dickson (2007). Institutional Issues in the CBFM-2 Project. International Conference on Community Based Approaches to Fisheries Management, Dhaka, Bangladesh.

Ahmed, M., H. Navy, L. Vuthy and M. Tiongco (1998). Socio-Economic Assessment of Freshwater Capture Fisheries of Cambodia: Report On a Household Survey. M. R. Commission. Phnom Penh, Cambodia**:** 186.

Alchian, A. A. (1950). "Uncertainty, Evolution and Economic Theory." Journal of Political Economy **58**(3): 211-221.

Alchian, A. A. (1961). Some Economics of Property. The collected works of Armen A. Alchian. D. K. Benjamin. Indianapolis, Indiana, Liberty Fund. 2006. Reprint from RAND Corp. 1961. **2**.

Alchian, A. A. (1965). Some Economics of Property Rights. Economic Forces at Work. Indianapolis, Liberty Fund 1977. Previously published in Il Politico 30, No.4 (1965): 816-829.

Alchian, A. A. and H. Demsetz (1973). "Property Right Paradigm." Journal of Economic History **33**(1): 16-27.

Alston, L. J. and B. Mueller (2005). Property Rights and the State. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 573-590.

Andreoni, J. (1988). "Why Free Ride? - Strategies and Learning in Public Goods Experiments." Journal of Public Economics **37**: 291-304.

Axelrod, R. (1980a). "Effective Choice in the Prisoners-Dilemma." Journal of Conflict Resolution **24**(1): 3-25.

Axelrod, R. (1980b). "More Effective Choice in the Prisoners-Dilemma." Journal of Conflict Resolution **24**(3): 379-403.

Axelrod, R. (1984). The Evolution of Cooperation. New York, Basic Books.

Baert, P. (2005). Philosophy of the social sciences: towards pragmatism. Cambridge, UK; Malden, MA, Polity Press.

Baland, J. M. and J. P. Platteau (1996). Halting degradation of natural resources: is there a role for rural communities. Oxford, UK. , Oxford University Press.

Banks, J., C. Plott and D. Porter (1988). "An experimental analysis of unanimity in public goods provision mechanisms." Review of Economic Studies **55**(182): 301-322.

Baran, E. (2005). Cambodian Inland Fisheries: Facts, Figures and Context. Penang, Malaysia, The WorldFish Center.

Baran, E., T. Jantunen and C. C. Kieok (2007). Values of Inland Fisheries in the Mekong River Basin, The WorldFish Center.

Barr, J. J. F. and P.-J. Dixon (2001). Methods for consensus building for management of common property resources. Newcastle, United Kingdom, University of Newcastle, Centre for Land Use and War Resources Research.

Bekhechi, M. A. and L. Lund (2009). Cambodia Land Management and Administration Project. Enhanced Review Report. World Bank.

Berg, J., J. Dickhaut and K. McCabe (1995). "Trust, Reciprocity, and Social History." Games and Economic Behavior **10**: 122-142.

Binh, L. T. (2003). Proposals for a National Strategy on Sustainable Management of Wetlands in Vietnam. Wetlands Management in Vietnam: Issues and Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WorldFish Center.

Bischoff, I. (2007). "Institutional choice versus communication in social dilemmas-An experimental approach." Journal of Economic Behavior & Organization **62**: 20-36.

Bohm, P. (1972). "Estimating demand for public goods: An experiment." European Economic Review **3**: 111-130.

Bonheur, N., M. Kosal, M. Kosal, K. Sour and S. L. Song (2005). Towards a holisitic approach to wetland governance: The legal and institutional framework and economic valuation of wetland resources in Cambodia. Wetlands Governance in the Mekong Region. Country Reports on the Legal-Institutional Framework and Economic Valuation of Aquatic Resources. E. Oh, B. Ratner, S. Bush, K. Kolandi and T. Y. Too. Penang, Malaysia, The WorldFish Center**:** 11-14.

Bromley, D. W. (1991). Environment and Economy: Property Rights and Public Policy. Cambridge, MA, Basis Blackwell, Inc.

Brousseau, E. and J.-M. Glachant (2008). New institutional economics: a guidebook. Cambridge, UK; New York, Cambridge University Press.

Brown-Kruse, J. and D. Hummels (1993). "Gender effects in laboratory public goods contribution. Do individuals put their money where their mouth is?" Journal of Economic Behavior & Organization **22**: 255-267.

Buchan, J. M., R. T. Croson and E. J. Johnson (1999). Getting to Know You: An International Experiment of the Influence of Culture, Communication, and Social Distance on Trust and Reciprocity. Philiadelphia, University of Philiadelphia, Wharton School Working Paper.

Cai, H. H. (2003). Situation Analysis and Training Needs Assessment of Natural Resource Management Stakeholders in the Mekong Delta. Wetlands Management in Vietnam: Issues and Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WorldFish Center.

Cai, H. H., D. T. Ha, N. An and T. T. Giang (2005). The legal and institutional framework and economic valuation of wetlands in the Mekong River Delta of Vietnam: A wetlands approach. Wetlands Governance in the Mekong Region. Country Reports on the Legal-Institutional Framework

and Economic Valuation of Aquatic Resources. E. Oh, B. Ratner, S. Bush, K. Kolandi and T. Y. Too, The WorldFish Center**:** 15-19.

Camerer, C. (2003). Behavioral Game Theory: Experiments in Strategic Interaction. Princeton, Princeton University Press.

Cardénas, J.-C. (2000). "How Do Groups Solve Local Commons Dilemmas? Lessons from Experimental Economics in the Field." Environment, Development and Sustainability **2**(3-4): 305-322.

Cardénas, J.-C. (2003). "Real Wealth and Experimental Cooperation: Evidence from Field Experiments." Journal of Development Economics **70**(2): 263-289.

Cardénas, J.-C., T. K. Ahn and E. Ostrom (2003). "Communication and Cooperation in a Common-Pool Resource Dilemma: A Field Experiment." Workshop in Political Theory and Policy Analysis **W03-15**.

Cardénas, J.-C., J. Stranlund and C. Willis (2000). "Local environmental control and institutional crowding-out." World Development **28**: 1719-1733.

Carpenter, J. P., A. G. Daniere and L. M. Takahashi (2004). "Cooperation, trust, and social capital in Southeast Asian urban slums." Journal of Economic Behavior & Organization **55**: 533-551.

Casajus, A. and A. Tutic (2007). Allmenderessourcen, Märkte und die Unsichtbare Hand. Leipzig, Universität Leipzig, Wirtschaftswissenschaftliche Fakultät, Professur für Mikroökonomik**:** 12.

Casari, M. and C. R. Plott (2003). "Decentralized management of common property resources: experiments with a centuries-old institution." Journal of Economic Behaviour & Organization **51**: 217-247.

Central Intelligence Agency (CIA) (2009). The WorldFactbook Central Intelligence Agency, from https://www.cia.gov/library/publications/the-world-factbook/.

Challenge Program on Water and Food (CPWF) (2005). "CGIAR Challenge Program on Water and Food." Retrieved 1.12.2010, from http://www.waterandfood.org/.

Chambers, R. (1994). "The origins and practice of participatory rural appraisal." World Development **22**(7): 953-969.

Ciriolo, E. (2007). "Inequity aversion and trustees' reciprocity in the trust game." European Journal of Political Economy **23**(4): 1007-1024.

Ciriolo, E. (2007). Trust: deep-rooted community attitude or reciprocity-based behavioural norm? Dulbea Document de Travail. **No 05-20.RS**.

Coase, R. H. (1937). "The nature of the firm." Economica **4**: 386-405.

Coase, R. H. (1998). "The new institutional economics." American Economic Review **88**(2): 72-74.

Coleman, J. S. (1987). Norms as Social Capital. Economic Imperialism: the economic approach applied outside the field of economics. G. Radnitzky and P. Bernholz. New York, Paragon.

Coleman, J. S. (1990). Foundations of Social Theory. Cambridge, Mass, Belknap Press.

Colletta, N. and M. Cullen (2000). Violent conflict and the transformation of social capital: Lessons from Cambodia, Rwanda, Guatemala and Somalia. Washington D.C., World Bank Publishers.

Commons, J. R. (1934). "Institutional Economics." American Economic Review **21**(4): 648-657.

Cox, J. C. (2004). "How to Identify Trust and Reciprocity." Games and Economic Behavior **46**(260-281).

Crawford, S. and E. Ostrom (1995). "A grammar of institutions." American Political Science Review **89**: 582-600.

Creswell, J. W. (2003). Research Design. Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, CA, Sage.

Creswell, J. W. and V. L. Plano Clark (2007). Designing and Conducting Mixed Methods Research. Thousand Oaks, CA, Sage.

Dalton, R. J., P. M. Hac, P. T. Nghi and N.-N. T. Ong (2001). Social Relations and Social Capital in Vietnam: The 2001 World Values Survey.

Dawes, R. M. (1980). "Social Dilemmas." Annual Review Psychology **31**: 169-93.

Dawes, R. M., J. McTavish and H. Shaklee (1977). "Behavior, Communication, and Assumptions About Other Peoples Behavior in a Commons Dilemma Situation." Journal of Personality and Social Psychology **35**(1): 1-11.

Dawes, R. M., J. M. Orbell, R. T. Simmons and A. J. C. Vandekragt (1986). "Organizing Groups for Collective Action." American Political Science Review **80**(4): 1171-1185.

Deininger, K. and M. Kirk (2003). "Land policy, poverty alleviation and sustainable rural development." Agriculture and Rural Development **10**(2): 44-47.

Demsetz, H. (1967). "Toward a theory of property rights." American Economic Review **57**: 347-359.

Demsetz, H. (1988). Ownership, Control, and the Firm. The Organization of Economic Activity. Oxford, UK, Basil Blackwill.

Denzin, N. K. and K. E. Ryan (2007). Qualitative Methodology (Including Focus Groups). The SAGE handbook of social science methodology. W. Outhwaite and S. P. Turner. Los Angeles; London, Sage**:** 578-594.

Dey, M. M., N. Sheriff and T. Björndal (2006). "Aquaculture Development in Asia: Current Status, Economics and Future Outlook." SNF Working Paper **42/06**.

Di Gregorio, M., K. Hagedorn, M. Kirk, B. Korf, N. McCarthy, R. Meinzen-Dick and B. Swallow (2004). The Role of Property Rights and Collective Action for Poverty Reduction. Washington DC 2009-1002, International Food Policy Research Institute.

Di Gregorio, M., K. Hagedorn, M. Kirk, B. Korf, N. McCarthy, R. Meinzen-Dick and B. Swallow (2008). "Property Rights, Collective Action, and Poverty: The Role of Institutions for Poverty Reduction." Capri Working Paper **81**.

Dietz, T., E. Ostrom and P. C. Stern (2003). "The Struggle to Govern the Commons." Science **302**(5652): 1907-1912.

Do, Q.-T. and L. Iyer (2004). Rural Vietnam in Transition. World Bank.

Edwards, P., D. Little and H. Demaine (2002). Rural Aquaculture. CABI Publishing, UK Department for International Development (DFID).

Erlei, M., M. Leschke and D. Sauerland (2007). Neue Institutionenökonomik. Stuttgart, Germany, Schäffer-Poeschel Verlag.

Farmer Water User Community (FWUC) (2004). Community By-Law: Farmer Water User Community - Ton Lop Irrigation Scheme, Cambodia.

Fehr, E. and S. Gächter (2000). "Cooperation and Punishment in Public Goods Experiments." American Economic Review **90**(4): 980-994.

Fehr, E. and B. Rockenbach (2003). "Detrimental effects of sanctions on human altruism." Nature **422**: 137-140.

Field, A. J. (1984). "Microeconomics, Norms, and Rationality." Economic Development and Cultural Change **32**(4): 683-711.

Flick, U. (2006). An introduction to qualitative research. London; Thousand Oaks, Calif., Sage Publications.

Flood, M. M. (1958). "Some Experimental Games." Management Science **5**(1): 5-26.

Fontana, A. and J. H. Frey (2005). The interview: From neutral stance to political involvement. The Sage Handbook of Qualitative Research. N. K. Denzin and Y. S. Lincoln. Thousand Oaks, CA, Sage Publications**:** 695-728.

Food and Agriculture Organization of the United Nations (FAO) (2003). Review of the state of world fishery resources: inland fisheries. Fisheries Circular. Food and Agriculture Organization of the United Nations. Rome, Italy. **942:** 68.

Food and Agriculture Organization of the United Nations (FAO) (2006a). "Country: Cambodia." Compendium of Food and Agriculture Indicators 2006 from http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=KHM&subj=4.

Food and Agriculture Organization of the United Nations (FAO) (2006b). "Country: Viet Nam." Compendium of Food and Agriculture Indicators 2006 from http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=VNM&subj=4.

Food and Agriculture Organization of the United Nations (FAO) (2009a). "Fishery and Aquaculture Country Profile Cambodia." Retrieved 3rd of March 2009, from http://www.fao.org/fishery/countrysector/FI-CP_KH/en.

Food and Agriculture Organization of the United Nations (FAO) (2009b). "Fishery and Aquaculture Country Profile Vietnam." Retrieved 3rd of March 2009, from http://www.fao.org/fishery/countrysector/FI-CP_VN/en.

Food and Agriculture Organization of the United Nations (FAO) (2009c). "Major Food and Agricultural Commodities and Producers." from http://www.fao.org/es/ess/top/commodity.html?lang=en&item=27&year=2005.

Frey, B. S. (1994). "How Intrinsic Motivation is Crowded out and in." Rationality and Society 1994 **6**: 334-352.

Fukuyama, F. (1995). Trust. The Social Virtues and the Creation of Prosperity. New York, Free Press.

Furubotn, E. and S. Pejovich (1972). "Property rights and economic theory: A survey of recent literature." Journal of Economic Literature **10**(4): 1137-1162.

Gächter, S. and E. Renner (2004). "Leading by example in the presence of free-rider incentives." Working Paper University of St. Gallen.

Ganz, J. S. (1971). Rules: a systematic study. The Hague, Mouton.

Giang, T. T., H. H. Cai and L. Q. Thong (2003). Wetlands Study: Lessons Learned and Future Challenges. Wetlands Management in Vietnam: Issues and Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WorldFish Center.

Gibson, C. C., J. T. Williams and E. Ostrom (2005). "Local enforcement and better forests." World Development **33**(2): 273-284.

Gintis, H. (2000). Game theory evolving. Princeton, NJ, Princeton University Press.

Glaeser, E. L., D. I. Laibson, J. A. Scheinkman and C. L. Soutter (2000). "Measuring Trust." The Quarterly Journal of Economics **115**(3): 811-846.

Gonsalves, J., T. Becker, A. Braun, D. Campilan, D. D. Chavez, E. Fajber, M. Kapiriri, J. Rivaca-Caminade and R. Vernooy (2005). Participatory Research and Development for Sustainable Agriculture and Natural Resource Management: A Sourcebook. Volume 1: Understanding Participatory Research and Development. Ottawa, Canada, International Potato Centre-User's Perspectives With Agricultural Research and Development, Laguna Philippines and International Development Research Centre.

Grootaert, C. (1999). "Social Capital, Household Welfare and Poverty in Indonesia." Local Level Institutions Working Paper Series **6**.

Guba, E. G. (1990). The alternative paradigm dialog. The Paradigm Dialog. E. G. Guba. Newbury Park, CA, Sage.

Güth, W., M. V. Levati, M. Sutter and E. Van der Heijden (2004). "Leadership and cooperation in public goods experiments." Discussion Paper on Strategic Interaction No. 29-2004. Max Planck Institute for Research into Economic Systems, Jena.

Guttman, H. (1999). "Ricefield fisheries - a resource for Cambodia." ICLARM Q. **22**(2): 11-15.

Hadfield, G. K. (2005). The Many Legal Institutions that Support Contractual Commitments. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 175-203.

Hardin, G. (1968). "The Tragedy of the Commons." Science **162**(1243-48).

Hardin, G. (1998). "Extension of The Tragedy of the Commons " Science **289**(5364): 682-683.

Harrison, G. W. and J. A. List (2004). "Field Experiments." Journal of Economic Literature **XLII**: 1009-1055.

Heng, K. (2007). CPW35- Community-Based Fish Culture in Seasonal Floodplains. Cambodia Record Sheet. Phnom Penh, Fisheries Administration.

Heng, K. and S. Pich (2008a). Constraints on the Process of Fish Culture Group Forming in Potamom and Thnal Kaeng, Prey Veng Province. Phnom Penh, Fisheries Administration.

Heng, K. and S. Pich (2008b). Draft Annual Progress Report. Community-based Fish Culture in Seasonal Floodplains and Irrigation Systems (CP35). Phnom Penh, Fisheries Administration.

Heng, K. and S. Pich (2008c). Draft Report on Biological Work. Community-based Fish Culture in Seasonal Floodplains and Irrigation Systems (CP35). Phnom Penh, Fisheries Administration.

Henrich, J., R. Boyd, S. Bowles, C. Camerer, E. Fehr, H. Gintis, R. McElreath, M. Alvard, A. Barr, J. Ensminger, N. S. Henrich, K. Hill, F. Gil-White, M. Gurven, F. W. Marlowe, J. Q. Patton and D. Tracer (2005). "'Economic man' in cross-cultural perspective: Behavioral experiments in 15 small-scale socities." Behavioral And Brain Sciences **28**.

Hobbes, T. (1651). Leviathan or the Matter, Form and Power of a Commonwealth Ecclesiastical and Civil. New York, Touchstone.

Hodgson, G. M. (1988). Economics and institutions: a manifesto for a modern institutional economics. Philadelphia, University of Pennsylvania Press.

Hodgson, G. M. (1998). "The approach of institutional economics." Journal of Economic Literature **36**(1): 166-192.

Hodgson, G. M. (2004a). The evolution of institutional economics: agency, structure, and Darwinism in American institutionalism. London; New York, Routledge.

Hodgson, G. M. (2004b). "Reclaiming habit for institutional economics." Journal of Economic Psychology **25**(5): 651-660.

Holler, M. and G. Illing (1993). Einführung in die Spieltheorie. Berlin Heidelberg, Springer Verlag.

Howe, K. R. (1988). "Against the quantitative-qualitative incompatability thesis, or, Dogmas die hard." Educational Researcher **17**: 10-16.

Innocenti, A. and M. G. Pazienza (2006). "Altruism and Gender in the Trust Game." University of Siena. Department of Economics Working Paper **5/2006**.

International Fund for Agricultural Development (IFAD) (2001). Enhancing Ownership and Sustainability. A Resource Book on Participation. Phillippines and India, International Fund for Agricultural Development.

Isaac, R. M., K. McCue and C. Plott (1985). "Public goods provision in an experimental environment." Journal of Public Economics **26**: 51-74.

Isaac, R. M. and J. M. Walker (1988). "Communication and Free-Riding Behavior - the Voluntary Contribution Mechanism." Economic Inquiry **26**(4): 585-608.

Isaac, R. M. and J. M. Walker (1991). Costly communication: An experiment in a nested public goods problem. Laboratory Research in Political Economy. T. Palfrey. Ann Arbor, University of Michigan Press.

Joffre, O. (2008). Incentives and Discontinuance Analysis in Truong Phu B Hamlet, Thoi Lai Commune, Co Do District, Can Tho City, The WorldFish Center.

Kähkönen, S. (1999). Does Social Capital Matter in Water and Sanitation Delivery? A Review of Literature. Social Capital Initiative Working Paper. Washington, DC, The World Bank. Social Development Family. Environmentally and Socially Sustainable Development Network. **9**.

Keskinen, M. (2003). The Great Diversity of Livelihoods? Socio-economic survey of the Tonle Sap Lake. Department of Civil and Environmental Engineering., Helsinki University of Technology, Helsinki. **MSc:** 140.

Kim, O. and M. Walker (1984). "The Free Rider Problem - Experimental-Evidence." Public Choice **43**(1): 3-24.

Kirk, M. (2004). "State Land Economics in Cambodia." Policy Discussion Paper, Ministry of Land Management, Urban Planning and Construction, Land Management and Administration Project, Philipps-University Marburg, Germany, 2. revised version, Phnom Penh, Marburg, July, 2004.

Kirk, M. and N. D. A. Tuan (2009). Exiting from Collective Agriculture: Land-tenure reform in Vietnam. Millions Fed. Proven Successes in Agricultural Development. D. J. Spielman and R. Pandya-Lorch, International Food Policy Research Institute.

Kiser, L. and E. Ostrom (1982). The three worlds of action. Strategies of Political Enquiry. E. Ostrom. Beverly Hills, Sage**:** 179-222.

Knack, S. and P. Keefer (1997). "Does Social Capital have an Economic Payoff? A Cross-Country Investigation." Quarterly Journal of Economics **52**(4): 1251-1287.

Kugler, T., M. G. Kocher, M. Sutter and G. Bornstein (2007). "Trust between individuals and groups: Groups are less trusting than individuals but just as trustworthy." Journal of Economic Psychology **28**: 646-657.

Lacoursiere, J. O., M. Torell and S. Choowaew (1998). Inventory and management of wetlands in the Lower Mekong Basin. Review and Assessment report for phase I (1990-1996). Mekong River Commission Secretariat (MRCS), Bangkok, Thailand.

Larson, B. A. and D. W. Bromley (1990). "Property rights, externalities, and resource degradation. Locating the tragedy." Journal of Development Economics **33**: 235-262.

Ledyard, J. O. (1995). Public Goods: A Survey of Experimental Research. The Handbook of Experimental Economics. J. H. Kagel and A. E. Roth. Princeton, New Jersey, Princeton University Press**:** 111-194.

Levati, M. V., M. Sutter and E. Van der Heijden (2007). "Leading by example in a public goods experiment with heterogeneity and incomplete information." Journal of Conflict Resolution **51**(5): 793-818.

Libecap, G. (1989). Contracting for Property Rights. Cambridge, MA, Cambridge University Press.

Libecap, G. (1995). The conditions for successful collective action. Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains. R. Keohane and E. Ostrom. London, Sage**:** 161-90.

Loewenstein, G. (1999). "Experimental Economics from the Vantage-Point of Behavioural Economics." The Economic Journal **109**: F25-F34.

Long, J. S. (1997). Regression Models for Categorical and Limited dependent variables. Thousands Oaks, California, Sage Publications.

Luce, R. D. and H. Raiffa (1957). Games and decisions; introduction and critical survey. New York, Wiley.

Marczyk, G. R., D. DeMatteo and D. Festinger (2005). Essentials of research design and methodology. Hoboken, N.J., John Wiley & Sons.

Marshall, G. (1998). A dictionary of sociology. New York, Oxford University Press.

Marwell, G. and R. E. Ames (1979). "Experiments on the Provision of Public-Goods: 1. Resources, Interest, Group-Size, and the Free-Rider Problem." American Journal of Sociology **84**(6): 1335-1360.

Mason, C. F., O. R. Phillips and D. B. Redington (1991). "The role of gender in a non-cooperative game." Journal of Economic Behavior and Organization **15**: 215-235.

Mayer, R. C., J. H. Davis and F. D. Schoorman (1995). "An Integrative Model of Organisational Trust." Academy of Management Review **20**(3): 709-734.

McKenny, B. and P. Tola (2002). Natural resources and rural livelihoods in Cambodia: a baseline assessment. Cambodia Development Resource Institute (CDRI) Working Paper. **23:** 116.

Meinzen-Dick, R. and M. Di Gregorio (2004). Collective action and property rights for sustainable development. Washington, D.C., International Food Policy Research Institute.

Meinzen-Dick, R. and A. Knox (1999). Collective Action, Property Rights, and Devolution of Natural Resource Management: A Conceptual Framework. International Conference on Collective Action, Property Rights and Devolution of Natural Resource Management: Exchange of Knowledge and Implication for Policy, Puerto Azul, The Philippines, Zentralstelle für Ernährung und Landwirtschaft (ZEL). Food and Agriculture and Development Centre.

Mekong River Commission (MRC) (2009). "About the Mekong." Retrieved 1st of March 2009, from http://www.mrcmekong.org/about_mekong/about_mekong.htm.

Ménard, C. (2005). An New Institutional Approach to Organization. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 281-318.

Ménard, C. and M. M. Shirley (2005). Handbook of New Institutional Economics. Introduction. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 1-18.

Merton, R. and P. Kendall (1946). "The focused interview." American Journal of Sociology **51**: 541-547.

Morales, E. J. and D. C. Little (2007). Self-recruiting species (SRS) from farmer-managed aquatic systems – the contribution of non-stocked species to household livelihood. Assessment of freshwater fish seed resources for sustainable aquaculture. . M. G. Bondad-Reantaso. Rome, FAO Fisheries Technical Paper. No. 501**:** 603–616.

Morse, J. M. (2003). Principles of Mixed Methods and Multimethod Research Design. Handbook of Mixed Methods in Social and Behavioral Research. A. Tashakkori and C. Teddlie. Thousand Oaks, CA, Sage Publications, Inc.**:** 189-208.

Moxnes, E. and E. Van der Heijden (2003). "The effect of leadership in a public bad experiment." Journal of Conflict Resolution **47**: 773-795.

MSN Encarta (2009). "Map of Mekong (river), Asia." Retrieved 23.02.2009, from http://encarta.msn.com/map_701514607/mekong.html.

Muller, A. and M. Vickers (1996). Communication in a Common Pool Resource Environment with Probabilistic Destruction, McMaster University, Department of Economics**:** 27.

Nang, D. (2003). Wetlands Protection and Management in Vietnam. Wetlands Management in Vietnam: Issues and Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WorldFish Center.

Nash, J. F. (1950). Non-Cooperative Games. Department of Mathematics, Faculty of Princeton University. **PhD**.

National Institute of Statistics (NIS) (2005). Statistical Yearbook 2005. Kingdom of Cambodia. Phnom Penh, Cambodia, National Institute of Statistics, Ministry of Planning.

Ngaido, T. and M. Kirk (1999). Collective Action, Property Rights, and Devolution of Rangeland Management: Selected Examples from Africa and Asia. Collective Action, Property Rights, and Devolution of Natural Resource Management. Exchange of Knowledge and Implications for Policy, Puerto Azul, The Philippines, German Foundation for International Development.

Norlund, I. (2007). "Civil Society in Vietnam. Social Organisations and Approaches to New Concepts." Asien **105**: 68-90.

North, D. (1990). Institutions, Institutional Change and Economic Performance, New York; Cambridge University Press.

North, D. C. (1994). Institutional Change: A Framework of Analysis, EconWPA.

North, D. C. (1995). The New Institutional Economics and Third World Development. The New Institutional Economics and Third World Development. J. Harriss, J. Hunter and C. M. Lewis. London, Routledge**:** 17-26.

Olson, M. (1965). The Logic of Collective Action. Public Goods and the Theory of Groups. Cambridge, Mass, Harvard University Press.

Orbell, J. M., P. Schwartz-Shea, R. M. Dawes and D. Elvin (1992). Gender as a basis for choosing partners in prisoner's dilemma games. Technical Report, University of Oregon Ethis.

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. New York, Cambridge University Press.

Ostrom, E. (1998). "A Behavioral Approach to the Rational Choice Theory of Collective Action." American Political Science Review **92**(1): 1-22.

Ostrom, E. (2005a). Doing Institutional Analysis. Digging Deeper Than Markets and Hierarchies. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 819-848.

Ostrom, E. (2005b). Understanding Institutional Diversity Princeton, NJ, Princeton University Press.

Ostrom, E. (2007). "A Diagnostic Approach For Going Beyond Panaceas." PNAS **104**(39): 15181-15187.

Ostrom, E., R. Gardner and J. Walker (1994). Rules, Games, and Common-Pool Resources. Ann Arbor, Michigan, University of Michigan Press.

Ostrom, E. and J. Walker (1991). Communications in a Commons: Cooperation without External Enforcement. Laboratory Research in Political Economy. T. R. Palfrey. Ann Arbor, University of Michigan Press**:** 287-322.

Ostrom, E., J. Walker and R. Gardner (1992). "Covenants With and Without a Sword - Self-Governance Is Possible." American Political Science Review **86**(2): 404-417.

Ostrom, V. (1980). "Artisanship and Artifact." Public Administration Review **40**(4): 309-317.

Ostrom, V. and E. Ostrom (1977). Public Goods and Public Choices. Alternatives for Delivering Public Services: Toward Improved Performance. E. S. Savas. Boulder, CO, Westview Press**:** 7-49.

Parsons, T. (1940). "The Motivation of Economic Activities." Canadian Journal of Economics and Political Science **6**: 187-203.

Pich, S. and K. Heng (2007). Report of Stakeholder Meetings on "Community Based Fish Culture in Irrigation Systems and Seasonal Floodplains". CARE Office, Kampong Trabek District, Prey Veng Province, 13th of July 2007 and Chamroeun Cheat Khmer (CCK) Office, Koh Andet District, Takeo Province, 16th of July 2007.

Poppe, M. and L. Utens (1986). "Effects of greed and fear of being gypped in a social dilemma situation with changing pool size." Journal of Economic Psychology **7**: 61-73.

Poteete, A., M. A. Janssen and E. Ostrom (2010). Working Together. Collective Action, the Commons and Multiple Methods in Practice. Princeton and Oxford, Princeton University Press.

Poteete, A. and E. Ostrom (2008). "Fifteen Years of Empirical Research on Collective Action in Natural Resource Management: Struggling to Build Large-N Databases Based on Qualitative Research." World Development **36**(1): 176–195.

Ravallion, M. and D. van de Walle (2003). Land Allocation in Vietnam's Agrarian Transition, World Bank Policy Research Working Paper 2951, World Bank.

Roberts, L. (1983). Experimental methods: problems of design and ethics. An Introduction to Social Research. A Handbook of Social Science Methods. R. B. Smith. Cambridge, Massachusetts, Ballinger Publishing Company. **1:** 325-363.

Roth, A. E. (1995). Introduction to Experimental Economics. The Handbook of Experimental Economics. J. H. Kagel and A. E. Roth. Princeton, New Jersey, Princeton University Press**:** 3-109.

Rousseau, D. M., S. B. Sitkin, R. S. Burt and C. Camerer (1998). "Introduction to Special Topic Forum. Not So Different After All: A Cross-Discipline View of Trust." Academy of Management Review **23**(3): 393-404.

Royal Government of Cambodia (RGC) (2001a). Draft Fisheries Law. Phnom Penh, Cambodia, Ministry of Agriculture, Forestry, and Fisheries, Royal Government of Cambodia.

Royal Government of Cambodia (RGC) (2001b). Land Law. Phnom Penh, Cambodia.

Royal Government of Cambodia (RGC) (2007). Law on Water Resources Management of the Kingdom of Cambodia. Phnom Penh, Cambodia.

Rubin, P. H. (2005). Legal Systems as Frameworks for Market Exchange. Handbook of New Institutional Economics. C. Ménard and M. M. Shirley. AA Dordrecht, The Netherlands, Springer**:** 205-228.

Sally, D. (1995). "Conversation and Cooperation in Social Dilemmas - a Metaanalysis of Experiments from 1958 to 1992." Rationality and Society **7**(1): 58-92.

Sandler, T. (1992). Collective Action: Theory and application, Ann Arbor: The University of Michigan Press.

Sauermann, H. (1967). Contributions to experimental economics. Tübingen, Mohr-Siebeck, Tübingen.

Schlager, E. (1994). Fishers' institutional responses to common-pool resource dilemmas. Ann Arbor, Michigan, University of Michigan Press.

Schlager, E., W. Blomquist and S. Y. Tang (1994). "Mobile Flows, Storage, and Self-Organized Institutions for Governing Common-Pool Resources." Land Economics **70**(3): 294-317.

Schlager, E. and E. Ostrom (1992). "Property-Rights Regimes and Natural Resources: A Conceptual Analysis." Land Economics **68**(3): 249-262.

Scott, D. A. (1989). "A Directory of Asian Wetlands " Wetlands International Retrieved 23rd of March 2009, from http://ramsar.wetlands.org/ADirectoryofAsianWetlands/tabid/822/Default.aspx.

Shepsle, K. (1989). "Studying institutions: some lessons from the rational choice approach." Journal of Theoretical Politics **1**: 131-49.

Siegfried, T. (2006). A beautiful math : John Nash, game theory, and the modern quest for a code of nature. Washington, D.C., Joseph Henry Press.

Simon, H. A. (1957). Models of a man. New York, John Wiley.

Socialist Republic of Vietnam (SRV) (1998). The Law on Water Resource. No.8/1998/QH10 of May 20, 1998.

Socialist Republic of Vietnam (SRV) (2003). Fisheries Law.

Socialist Republic of Vietnam (SRV) (2004). Law on Land National Assembly.

Sophal, M. (2004). Sustainable Use and Mangement of Cambodian Wetlands: Social and Institutional Challenges. Wetlands Management in Cambodia: Socioeconomic, Ecological, and Policy Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, WordFish**:** 22-24.

Sour, K. and V. Hav (2004). Fisheries and Aquaculture in Cambodia's Wetland Environment. Wetlands Management in Cambodia: Socioeconomic, Ecological, and Policy Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, WordFish**:** 1-13.

Straffin, P. D. (1980). "The Prisoner's Dilemma." UMAP Journal **1**: 102-103.

Strauss, A. L. and J. M. Corbin (1998). Basics of qualitative research. Thousand Oaks, Sage Publications**:** xiii, 312 p.

Sultana, P. and P. Thompson (2003). Methods of consensus building for community based fisheries management in Bangaldesh and the Mekong delta. Capri Working Paper No.30. CAPRi. Washington, D.C., IFPRI.

Sverdrup-Jensen, S. (2002). Fisheries in the Lower Mekong Basin: Status and Perspectives. MRC Technical Paper No.6. M. R. Commission. Phnom Penh, Cambodia**:** 103pp.

Tashakkori, A. and C. Teddlie (2003). Major Issues and Controversies in the Use of Mixed Methods in the Social and Behavioural Sciences. Handbook of Mixed Methods in Social and Behavioral Research. A. Tashakkori and C. Teddlie. Thousand Oaks, CA, Sage Publications, Inc.**:** 3-50.

Taylor, M. (1987). The possibility of cooperation. Cambridge, Cambridge University Press.

Thayer, C. A. (2008). One party rule and the challenge of civil society in Vietnam. Remaking the Vietnamese Stata: Implications for Viet Nam and the Region., City University of Hong Kong, Hong Kong.

The WorldFish Center (WorldFish) (2005). CPWF-Challenge Program on Water and Food: Community Based Fish Culture in Irrigation Systems and Seasonal Floodplains (PN35). Project Proposal. The WorldFish Center. Penang, Malaysia**:** 15.

Thuok, N., M. Ahmed and S. Nuov (1996). Cambodia's Great Lake. How to Sustain its Ecological and Economic Diversity. Voices from the Commons- The Sixth Annual Conference of the International Association for the Study of the Commons, Berkley, USA.

Thurstone, L. L. (1931). "The indifference function." Journal of Social Psychology **2**: 139-167.

Torell, M. and A. M. Salamanca (2003). Wetlands Management in Vietnam's Mekong Delta: An Overview of the Pressures and Responses. Wetlands Management in Vietnam: Issues and Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WorldFish Center.

Torell, M., A. M. Salamanca and B. D. Ratner (2003). Wetlands Management in Vietnam: Issues and Perspectives. The World Fish Center. Penang, Malaysia.

Törhönen, M. and D. Palmer (2004). Land Administration in Post Conflict Cambodia. Symposium held by the International Federation of Surveyors, European UN-Headquaters, Palais des Nations, Geneva, Switzerland.

Tucker, A. W. (1950). "A two-person dilemma." Mimeo, Standford University. Published under the heading On Jargon: The prisoner's dilemma. UMAP Journal 1980 **1**: 101.

United Nations Development Programme (UNDP) (2007). 2007 UNDP Cambodia Annual Report. Annual Report. United Nations Development Programme Cambodia. Phnom Penh, Cambodia.

United Nations Development Programme (UNDP) (2008a). "2007/2008 Human Development Report." Human Development Reports Retrieved 3rd of April 2009, from http://hdr.undp.org/en/statistics/.

United Nations Development Programme (UNDP) (2008b). Human Development Statistics 2007/2008. Rome, United Nations Development Programme.

United Nations Development Programme (UNDP) (2008c). "Viet Nam at a Glance. A Human Development Overview." Retrieved 3rd of April 2009, from http://www.undp.org.vn/UNDP/About-Viet-Nam/Viet-Nam-at-a-Glance/.

United Nations Development Programme (UNDP) (2009). "UNdata. A world of information." Retrieved 15th of January 2010.

Van Acker, F. (1999). Hitting a stone with an egg? Cambodia's rural economy and land tenure in transition, CAS Discussion paper No. 23.

Van Acker, F. (2003a). Cambodia's commons: Changing governance, shifting entitlements?, CAS Discussion paper No. 42.

Van Acker, F. (2003b). Natural resource management and decentralization, Final Report, EU PRASAC II, Support Programme for the Agricultural Sector in Cambodia.

van der Heijden, E., J. Potters and M. Sefton (2006). "Hierarchy and Opportunism in Teams." Centre for Decision Research and Experimental Economics Discussion Paper **2006–15**.

van Zalinge, N., N. Thouk, S. Tana and D. Loeung (2000). Where There is Water, There is Fish? Cambodian Fisheries Issues in the Mekong River Basin. Common Property in the Mekong. Issues of

Sustainability and Subsistence. M. Ahmed and P. Hirsch. Manila, Philippines, The WorldFish Center**:** 37-48.

Vanhan, H. (2004). Agriculture in the Wetlands of Cambodia. Wetlands Management in Cambodia: Socioeconomic, Ecological, and Policy Perspectives. M. Torell, A. M. Salamanca and B. D. Ratner. Penang, Malaysia, The WordFish Center**:** 17-19.

Vollan, B. (2008). "Socio-ecological explanations for crowding-out effects from economic field experiments in southern Africa." Ecological Economics **67**: 560-573.

Von Neumann, J. and O. Morgenstern (1947). Theory of Games and Economic Behaviour. Princeton, Princeton University Press.

Vyrastekova, J. and S. Onderstal (2005). "The Trust Game Behind the Veil of Ignorance: A note on Gender Differences." CentER Discussion Paper **2005–96**.

Walker, J. M. and R. Gardner (1992). "Probabilistic Destruction of Common-Pool Resources - Experimental-Evidence." Economic Journal **102**(414): 1149-1161.

Wallis, W. A. and M. Friedman (1942). The empirical deviation of indifference functions. Studies in mathematical economics and econometrics, in memory of Henry Schultz. O. Lange, F. McIntyre and T. Yntema. Chicago,, The University of Chicago press**:** 175-189.

Weingart, A. and M. Kirk (2008). "Escaping Poverty Traps? Collective Action and Property Rights In Post-War Rural Cambodia." Capri Working Paper **89**.

Werthmann, C., C. Mai Thi Truc and T. Pham Ba Vu (2007). PRA Report CP35 in Vietnam. Ho Chi Minh City, Vietnam, Research Institute for Aquaculture No.2 and The WorldFish Center.

Williamson, O. E. (1975). Markets and hierarchies, analysis and antitrust implications : a study in the economics of internal organization. New York, Free Press.

Williamson, O. E. (2000). "The New Institutional Economics: Taking Stock, Looking Ahead." Journal of Economic Literature **XXXVIII**: 595-613.

Woolcock, M. (1998). "Social Capital and Economic Development: Toward a Theoretical Synthesis and Policy Framework." Theory and Society **27**: 151-208.

Zak, P. and S. Knack (2001). "Trust and Growth." Economic Journal **111**(295-321).

Appendix

SECTION A

The research schedule

Year	2006		2007				2008				2009				2010	
Quarter	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
1. Prepatory phase and site screening																
Ducument study (methodology and theory)																
Consultation with stakeholder																
Site selection Cambodia																
2. Action Research																
Situational Analysis and PRA																
Participatory Planning in case study sites																
Action Plan Development and Implementation																
Discontinuance Analysis																
3. Surveys																
Training of enumerators and pretesting																
Baseline Survey																
Monitoring Survey																
Seasonal Survey																
4. Experiments																
Training of research assistances and pretesting																
Implementation PG, CPR and TG																
5. Reports and summarising of findings																
Finacial and narrative report																
Field visit of PhD advisor																
Presentation of preliminary findings at WF																
CAPRi Working Paper																
Analysis of data																
PhD thesis write-up																

Table 16: The research schedule

The project and research sites

Village	Commune	District	Province	Country	Waterbody	Project implement ation	PRA	Case study sites	Surveys (Code)	Experiments
Potamoun	Svey Chrum	Mesang	Prey Veng	Cambodia	Potamoun reservoir	Dec 07	√		Baseline(402) Monitoring Seasonal	
Thnal Kaeng					Thnal Kaeng reservoir	Dec 07	√	√	Baseline (401) Monitoring Seasonal	√
Pom Eith	Prey Ampok	Kiri Vong	Takeo		Preak Tonloab reservoir	Dec 07	√	√	Baseline (403) Monitoring Seasonal	√
Chrey Poan	Krorpom Chhouk				Natural Pond	Dec 07	√		Baseline (404) Monitoring Seasonal	
Svay Tiep	Svay Teap		Kampong Cham			no project				√
Korsang		Dambei				no project				√
Chrang Krohom		Kampong Thom	Kampong Thom			no project				√
Leuk	Preah Domrei	Stoung				no project				√
Vinh Thoi	Vinh Hanh	Chau Thanh	An Giang	Vietnam	Long Xuyen Quadrangle Area	2006-2007			Baseline (303)	
Tan Cuong	Phu Cuong	Tam Nong	Dong Thap		Plain of Reed Area	2006-2007			Baseline (304)	
Thoi Trung	Thoi Dong	Co Do	Can Tho		Western part of Bassac River	2006-2007			Baseline (302)	
Truong Phu B	Thoi Lai					since 2007	√	√	Baseline (306) Monitoring Seasonal	√
D1	Thanh Thanh	Vinh Thanh			Long Xuyen Quadrangle Area	since 2006			Baseline (301)	
E2						2006-2007	√	√	Baseline (307) Monitoring Seasonal	√
C2						since 2007				
Hoa Hiep	Nguyen Van Thanh	Binh Minh	Vinh Long		Between Mekong and Bassac	2007-2008	√		Baseline (305)	

Table 17: The project and research sites

SECTION B
Example of HH list

No	Hamlet	Latin_Name	Sex	Status	Classification (KI)	Trap Pond	Culture pond	Long-term remittance	Short-term labour migration	Small-Scale commercial seasonal fishermen	functional landlessness	Comments	House NO	HH code in data base
1	HH		f	w	middle	x	x		daug in law			HHH died	1	
2	HH		f	m	better	4	x		x				2	305-16
3	HH		f	w	middle	2	x		x		x		3	305-34
4	HH		m	w	middle						x		4	
5	HH		m	m	better	3	x						5	
6	HH		m	m	better	3	x	children (5)	x				6	
7	HH		f	m	better	3	x						7	
8	HH		f	w	middle	x	x						8	
9	HH		m	m	middle	2	x		x		x		9	305-13
10	HH		f	m	middle			daughter	husband		x		10	
11	HH		m	m	better		x		HHH, son				11	305-23
12	HH		f	m	poor			sister					12	
13	HH		f	w	middle	x	x						13	
14	HH		f	m	better	x	x		son (2)				14	
15	HH		m	m	middle	x	x	daughter					15	
16	HH		m	m	better			child			x		16	
17	HH		f	w	middle	x	x	grandchild					17	
18	HH		m	m	better								18	
19	HH		m	m	better	x	x		sons				19	305-32
20	HH		f	w	middle	x	x						20	
21	HH		m	m	better	x	x	conqai					21	
22	HH		m	m	better	x	4						22	
23	HH		m	m	better	x		conthai		x			23	

Table 18: Example of HH list

Survey Questionnaire

A1 HH Details A1.1 HH Code| __ __ __ | __ __ |

A1.2 Village/hamlet _____ | __ __ __| A1.3 HH N^{o} |__ __|

A1.4 Waterbody _____ |__ __ __| **A1.5 Country** _____ |__|

A1.6 Province _____ |__ __| **A1.7 District** _____ |__ __ __ |

A1.8 Commune/Upazila (or local sub-district unit) _____ |__ __ __|

A1.9 Sub-village/ Para/ Campement etc. _____

A1.10 Head of HH name _____(Pers) _____(Fam)

A1.11 Ethnicity _____ |__ __|**A1.12 Religion** _____ |__ __|

A1.13 Caste _____ A1.14 Kinship/Clan/Chrom Group _____

AB Interview Details

AB3 Date (*dd/mm/yy*) ___ ___/___ ___/___ ___

AB4 Name of interviewer(s) _____ _____

AB5 Full name of respondent _____(Pers) AB6 _____(Fam)

AB7 Sex _____ **AB8 Relation to HH head** _____ |__ __|

AB9 Data checked by? _____ _____

AB10 Database entry date? (*dd/mm/yy*) ___ ___/___ ___/___ ___

A2 HH Member Details (Include those who are absent but considered to be members of the HH e.g. providing periodic income or other support)

A2.1 Member No	**A2.3 Relationship to head of house (pg.1)**	**A2.4 Sex M=1 F=2**	A2.5 Age (yrs)	**A2.6 Marital Status**	**A2.7 Health Status**	Education		A2.10 Months resident. last year	**A2.12 Occupation(s) 1ry, 2ndry etc[1]**				A2.14 Comments
						A2.8 Education .Level	A2.9 Years of Education		**1**	**2**	**3**	**4**	
1	Head												
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													

[1] enter multiple responses listed in order of importance to HH livelihood last year

A3 HH Assets and coping strategies

Table A3a Give details of main residence; ownership, structure materials and services (use direct observation as far as possible)

House details	Code
A3.1 House Location	
A3.2 N^{o} housing units in homestead	
A3.3 N^{o}. family units in homestead	
A3.4 Years oldest HH est.	
A3.5 Years this HH est.	
A3.6 Ownership of house plot	
A3.7 Total living space area (m2)	
A3.8 Total homestead area (m2)	
A3.10 Distance nearest neighbour (m)	
A3.11 Main roof material	
A3.12 Main wall material	
A3.13 Main floor material	
A3.14 Main light source	
A3.15 Main toilet-type	
A3.16 N^{o} families sharing toilet?	
A3.17 Main drinking water source	
A3.18 Main cooking Fuel	

A3.19 /20 If family, parents or grandparents moved to village, where did they come from?
_____ /_____ (District/Province) A3.21 In which year? _____
A3.22 Reason for move? _____

A3.23 How many months/ year do any HH members have to eat <3 meals/day? |__ __|
A3.24 How many months/ year do any HH members either have to reduce the normal quantity or quality of food eaten during meals? |__ __|
What proportion of your total annual rice crop did you sell during the last 5yrs?
A3.25 Min percent |__ __| A3.26 Max percent |__ __|

Table A3b Consumer Items, Livestock, Agricultural and Aquatic Production Assets

Quantify items by direct observation as far as possible.

A3.27 Item	A3.28	**A3.27 Item**	A3.28
Consumer Items	Quantity	**Production Items**	Quantity
1 Television		21 Mini/ 2-wheel tractor/ power tiller	
2 Radio/ stereo		22 Full size-tractor	
3 Refrigerator		23 Irrigation pump/ tube well	
4 Mobile phone		24 Open well or hand pump	
5 Land phone		25 Generator	
6 Electric fan		26 Boat or canoe	
7 Sewing machine		27 Motor for boat	
8 Cooker-LPG/kerosene/electric		28 Plough	
9 Wood burning stove		29 Animal cart	
10 Bicycle		30 Threshing Machine	
11 Motor bike		31 Rice Mill	
12 Car		32 Pesticide sprayer	
13 Truck/ van			
14 Car or lorry battery		**Fishing gears specify below**	
15 Solar panel		40 Fishing gears	
		41 Gill-net	
Livestock (owned last 3mnths)		42 Individual traps - baited	
71 Milk cattle		43 Barrage traps - non-baited	
72 Draft cattle		44 Cast-net	
73 Buffaloes		45 Long-line non-baited hooks	
74 Goat/ sheep		46 Two handed nets	
75 Pigs		47 Triangular net - hand operated	
76 Chicken (exc. juveniles)		48 Long-line baited hooks	
77 Ducks (exc. juveniles)		49 Hand-trap (downward action)	
78 Donkeys		50 Barrage net (sector net)	
79 Horses		51 Recovery net	
80 Camels		52 Seine net	
		53 Large seine net	
		54 Small seine net	
		55 Seine net	
Other observed items		56 Harpoon	
Other (specify)		57 Hook and line	
		58 Passive hook and line traps	
		59 Happa net	
		60 Lift net	

A4 Land Holdings and Farming Systems **TableA4** Give details of all distinct land holdings categorised by **Land Use** and **Tenure** (including the homestead area and any ponds or water-bodies**)** owned or used by the HH during previous year?

A4.2 Land Use	**A4.3 Tenure**	A4.4 No of plots	A4.5 Total Area	A4.6 Min plot area	A4.7 Max plot area	A4.8 Area Units	A4.9 Min Km to Hse	A4.10 Max Km to Hse	**A 4.11 Main crops grown during last 5yrs (rank in order of area cultivated) Pg.6**					**A4.13 Flood Regime Pg.6**	A4.14 Comments
1															

A5 Cropping and Inundation Characteristics

Table A5a Seasonal cropping practices – complete for all cultivated plots identified in Table A4. Use single column where cropping patterns were identical for multiple plots during the specified season

A5 Cultivation Count		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
A5.1 Land Use Code (pg.5)									
5.2 Cultivation season (1) main (2) secondary (3) third season									
5.3 Main crop cultivated last year (pg.6)									
5.4 Number of plots cultivated									
5.5 Total area cultivated (specify units)									
5.6 Specify unit									
5.7/8 Usual cultivation months	Start								
	End								
5.9 Total crop days from seed to harvest									
5.10 Nursery days prior to transplanting (rice)									
5.11 Pesticide application - main month (s)									
5.12 Total inorganic fertiliser last crop									
5.13 Total organic fertiliser last crop									
5.14 Fertiliser units (i.e. total kg or total kg/ha)									
5.15 Cultivation freq. last 5 yrs (0-5)									
5.16/17 Yield over last 5 yrs	Min								
	Max								
5.18 Yield Units (i.e. total kg or total kg/ha)									
5.19 Percent of crop sold									

Inundation Patterns

Table A5b Complete for all plots identified above (Table 5a) which are irrigated or flood.

Use **A5 Cultivation Count** (Table 5a) to refer to plot(s) with identical inundation/ cultivation characteristics

A5 Cultivation Count (see Table 5a)						
A5.20 Flood / Irrigation control (pg.6)						
5.21 Main irrigation/ flood source (pg.6)						
A5.22a/22b Km from flood or irrigation source	Min					
	Max					
A5.23 Mean height of field-dike (cm)						
A5.24 Frequency of inundation >30cm depth over last 5 yrs (0-5)						
A5.25 Pumped irrigation frequency						
A5.26 Gravity-fed irrigation frequency						
A5.27/28 Inundation duration >30cm depth over the last 5years (weeks)	Min					
	Max					
A5.29/30 Peak inundation depth over the last 5yrs (m)	Min					
	Max					
A5.32 Land title (pg.6)						
A5.33 Boundary disputes? (Yes=1, No=2)						
A5.34 Visible from house (pg.6)						
A5.35 Fishing rights (pg.6)						
A5.36 Rice fish enhancement activity over the last 10 years (pg.6)						

A6 Aquaculture Practice

Has anyone in the HH ever been involved in aquaculture production Yes ____ No ____

Table A6a Use the following table to document who and how different members are, or have been involved in aquaculture production (enter multiple species in A6.4 only for polyculture systems)

A6.1 Sys N°	**A6.2 Aqua System**	**A6.3 System Tenure**	**A6.4 HH member(s) (Relation to HHH) (Pg.1)**	A6.5/6 Years Involved (e.g. 1999-2006)		A6.7/8 Usual seasonal start/ end months	
1							
2							
3							
4							
5							
6							
7							

Table A6b Specify the species and seed-source for each of the aquaculture systems identified in Table A6a, specify the system No (A6.1). List species in rank order of importance i.e. highest volume first. For polyculture systems use one row for each species and/ or seed-source combination.

A6.1 Sys N°	**A6.9 Fish or Plant Species**	**A6.10 Source of seeds**

Table A6c For any **on-farm** aquaculture activities listed in Table A6a, specify system No (A6.1) and give details of the following inputs – consider mean production patterns over the last 5 years where possible

A6.1 Sys N^{o}	**A6.11 Dry season Water source?**	**A6.12 External Labour Inputs?**	**A6.13 Feeds and fertilisers applied?**	A6.14 No Meals Fed per Week	A6.15 percent Harvest Sold

A7 Processing and marketing of aquatic produce

Table A7a What was the fate of any fish or other aquatic plants and animals caught, cultured or purchased for resale by HH members over the last month (enter multiple species (A7.1) only where mixed lots sold i.e. for all similar combinations of responses to A7.2 to A7.11)

A7.1 Species/ varieties)	**A 7.2 Production Source (Pg.12)**	**A7.3 Form (Pg.12)**	**A7.4 Processing (Pg.12)**	**A7.5 Market Outlet (Pg.12)**	A7.6 Mean Size (kg)	A7.7 Total Quantity (kg)	A7.8 Purchase price (currency)	A7.9 Selling Price (currency)

Table A7b Which HH members were involved in the marketing or processing of aquatic produce over the last month – use one row per activity? List members in order of importance in terms of marketing activity (i.e. most important/ active first)

A7.11 HH Member(s) – See Page 1	**A7.12 Aquatic Marketing / Processing Activity**	A7.13 Comments

A8 Fish and Meat Consumption

Table A8 HH expenditure on fish and meat consumed over the last seven days? (Specify weight & currency units – use kg where possible)

A8.1 Fish/ meat category	**A8.2 Species/ Variety (Pg.9)**	**A8.3 Form (Pg.12)**	**A8.4 Source (Pg.12)**	A8.5 Total Quantity Consumed	**A8.6 Quantity Units (Pg.12)**	A8.7 Unit Price	**A8.8 Currency**	A8.9 No. Meals/ 7 Days	A8.10 N° persons fed
1 Fresh Fish									
2 Dried Fish									
3 Smoked Fish									
4 Fermented Fish									
5 Canned Fish									
6 Other aquatic animals									
7 Aquatic plants									
8 Dairy products	Eggs								
	Milk								
	Cheese								
9 Farmed Meat	Poultry								
	Beef								
	Pork								
	Mutton								
10 Wild meat/ game									
11 Pre-cooked restaurant food									

Section 9 Institutional Membership and Collective Activity

Table A9a Institutional Membership Is anyone in the HH a member of any group which organises collective activity. These may be formal (i.e. farming society, NGO group, co-operative, fishing society, religious society) or informal (i.e. rotating micro-credit group, shared labour groups).

A9.1 HH Member (use codes on Pg.1)	**A9.2 Type of group or organisation**	A9.3 N^{o} years involved	A9.4 N^{o} meetings attended last 12 months	**A9.5 Member Type**	**A9.6 Principle activities last 12 months**

Table A9b Collective Agriculture practices Do you undertake any of the following activities with other HHs in the village on a collective basis with members of other HHs? (specify any additional collective activities in blank rows)

A9.7 Collective production activities	**A9.8 Group Location**	**A9.9 Basis Collective Action**	A9.10 Details of co-ordinating authority/ institution, participation etc.
1 Field preparation			
2 Transplanting			
3 Crop security/ guarding			
4 Harvesting crops			
5 Maintain dikes/ water storage or distribution systems			
6 Guarding fish ponds or fisheries			
7 Collective fishing			
8 Maintaining public spaces, buildings, roads, temple areas etc			
9 Acquiring agric-production inputs			

Do you share access to any supplementary irrigation resource? Yes ___ No ___ If yes **Table A9c**

A9.11 Collective water management	**A9.12 Freq**	A9.13 Details of co-ordination, participation etc.
1 Synchronise field preparation?		
2 Synch same duration crop varieties?		
3 Synchronise water releases?		

Table A9d If you have experienced any disputes relating to other groups/ individuals relating to use of land and water over the last year, - complete the following table.

A9.14 Dispute with which group category (Pg.16)	**A9.15 Group Location**	A9.16 Describe the dispute or problem	**A9.17 Score**

A10 Health Problems

List health problems experienced by any HH member over the last 2 months?

A10.1 HH Member (Code P.1)	**A10.2 Health Problem**	**A10.3 Health Response**

A11 Remittances, savings and Credit

A11.1 How many people living/ working away from the main HH sent income home last year? _____

A11.2 & A11.3 Total income sent home last year (specify currency) _____

Last year, what proportion of your net annual HH cash income were you able to

A11.4 save (%) _____ A11.5 required to borrow (%) _____

Table A11a What were your HH's main credit requirements over the last year?

A11.6 Credit purpose	**A11.7 Credit Source**	A 11.8 Amount (specify currency)	A11.10 /11 Terms: Interest (percent) & Unit Time

A12 Shocks and Trends

Table A12a Tenurial change - Has your HH sold, lost or gained any land over the last 10yrs (e.g. through sale, degradation, illegal encroachment, family inheritance, govt. policy) Yes ____ No ____ If no go to Table A12b

A12.1 Original Land Use Type	**A12.2 Tenure Change**	A12.3 Year of change	A12.4 Describe the change and the reason(s) for it?

Livelihood Trends and Needs

Table A12b How have things improved over the last 5yrs - list and rank three or more factors which have contributed most to the improvement of your HH's livelihood security?

A12.5 Type of Improvement	A12.6 Rank

Table A12c How have things got worse over the last 5yrs - list and rank three or more factors which have contributed most to your HH livelihood becoming less secure?

A12.7 Type of Problem	A12.8 Rank

A12d Livelihood Outcomes

A12.9 Think about your previous responses – then circle one number which best describes how your overall HH livelihood security has changed over the last 5yrs?

1. Improved significantly? 2. Improved marginally? 3. Roughly the same?
4. Deteriorated marginally? 5. Deteriorated significantly?

A12e Living Aquatic Resource Trends

A12.10 Do you face any problems related to water availability or quality in your rice fields? Probe seasonality and freq. of probs. (This could be due to, unpredictable availability (drought flooding), competing family uses, competition with other users, pollution etc.)

_____

A12.11 Give reasons for any change in cultivation practices over the last 10yrs?

_____

A12.12 If any HH member has discontinued their involvement with fish or harvesting other wild animals and plants what were the reasons (which member, which system and why and when)?

_____

A12.13 If any HH member has discontinued their involvement with aquaculture – what were the reasons (specify which member, which system, why and when) ?

_____

A12.14 Describe and give reasons for any change in marketing and/ or post-harvesting activities practiced by your HH over the last 10 years?

_____

A13 Rice-Fish Preferences

A13.1 Would you be more inclined to participate in group or individual rice-fish – Give reasons for your answer? _____

A13.2 How do you think the technical design of collective rice-fish production in your village could be improved?

_____

A13.3 How could the collective organisation of rice-fish production in your village could be improved?

_____

A13.4 What might stop you from practicing collective rice-fish production?

_____

Please thank the respondent - remind them about the purpose of the survey and ask if we could revisit to administer a monitoring survey approx. once every 4-6 weeks?

Game instructions

General instructions before each game

Thank you all for taking the time to come today. Today we want to play a game with you and we will also ask you to fill out a small questionnaire after the game.
This game may take 2-3 hours/30 min., so if you think you will not be able to stay that long without leaving please let us know now. Before we begin I want to make some general comments about what we are doing here today and explain some rules that we need to follow. We will be playing a game for real money that you will take home. You should understand that this is not _____ (NAME OF RESEARCHER) own money. It is money given to him/her by her university to use to do a research study, which will eventually be part of a book. _____ (NAME OF RESEARCHER) is working with the _____ (NAME OF INSTITUTION) and she/he is a student. She/he is not the one taking decisions about any money or any project for the village. _____ is working together with many other students who are carrying out the same kind of games all around the world.
Before we proceed any further, let me say something that is very important. Many of you were invited here without understanding very much about what we are planning to do today. If at any time you find that this is something that you do not wish to participate in for any reason, you are of course free to leave whether we have started the game or not. But if you know now already, that you will not be able to stay for the rest of the day, then let us know now, because otherwise we cannot use the results. If you have heard about a game that has been played here in the past you should try to forget everything that you have been told. This is a completely different game. We are about to begin the game. It is important that you listen as carefully as possible, because only people who understand the game will actually be able to play it. We will run through some examples here before we start the real game.

The first rule, which is very important, is:
You cannot ask questions or talk about the game while we are here together.
This is very important and please be sure that you obey this rule, because it is possible for one person to spoil the game for everyone, in which case we would not be able to play the game today. Do not worry if you do not completely understand the game as we go through the examples here in the group. Each of you will have a chance to ask questions in private to be sure that you understand how to play.

Instructions for the PG game

This game is similar to a situation in which a group of people is asked to contribute to a development project. For this game, assume that you and three other villagers have to decide on a dike construction project. Each of you can decide how much money he/she wants to allocate to the project and how he/she you would like to keep for him/her. The dike will keep the fish in the fields and, thus, improves your life as you may catch more fish. But also the lives of the other players are improved, because they might catch more fish too. The development project thus will generate you and your fellow players extra gains that translate into payoffs for you. So you have to decide about how much money you give to the dike construction in each round. The reason why we use a dike construction project in this game is to represent real life situations in which your economic decisions will bring yourself monetary consequences. You will play several rounds.

To be able to play you will receive a box where you can store the money from each round. [GIVE A BOX TO EVERYBODY], then you receive an envelope [GIVE AN ENVELOPE TO EVERYBODY]. This is used for exchanging money between us and you. We will explain this later.

<u>The rules of the game are as follows:</u>
Each of you gets 1,000 Riel/10,000 VND per round as initial endowment. Now, in each round you have to decide how much out of the 1,000 Riel/10,000 VND you would like to contribute for the dike construction. You are only able to contribute in steps of 100 Riel/1,000 VND. You can contribute 0, 100, 200, 300, 400, 500, 600, 700, 800, 900 or 1,000 Riel/0, 1,000, 2,000….or 10,000 VND; this is your own decision. The money you want to contribute, you put into the envelope, the money you want to keep you put into the box in front of you. It is very important that we keep in mind that the decisions are absolutely individual, that is, that the amount of money you put into the envelope and the amount of money you put into the box are private and that you do not have to show them to the rest of the members of the group.

When all four players made their decision, the envelopes will be collected and put into a pot. This pot will be opened in public and you will know how much money will be invested for the dike construction. Still, you will not know how much the other players have put into their envelopes. The money contributed by all players will be doubled. As the dike serves everybody this amount will be distributed equally among all players, so each player gets the same amount of money out of the project no matter how much he/she contributed.
At the end of the round you will have the money you kept plus an equal share of what has been invested after it was doubled.

Here are some examples. During the game you can decide on your own, how much money you would like to contribute for the development project.
Let us see how the game works with an example: [FACILITATOR: show poster with the EXAMPLE.]
Example 1: Player A contributes 0 Riel/0 VND, player B contributes 200 Riel/2,000 VND, player C contributes 500 Riel/5,000 VND and player D contributes 100 Riel/1,000 VND. Together there are 800 Riel/8,000 VND in the pot for the development project. Now this amount is doubled to 1,600 Riel/16,000 VND. The 1,600 Riel/16,000 VND are now divided in four equal shares of 400 Riel and distributed to the players. After the round the players earned this:
Player A has 1,000/10,000 initial endowment minus 0 contributions plus 400/4,000 out of the project is 1,400 Riel/14,000 VND; Player B has 1,000/10,000 initial endowment minus 200/2,000 contributions plus 400/4,000 out of the project is 1,200 Riel/12,000 VND; Player C has 1,000/10,000 initial endowment minus 500/5,000 contributions plus 400/4,000 out of the project is 900 Riel/9,000 VND; Player D has 1,000/10,000 initial endowment minus 100/1,000 contributions plus 400/4,000 out of the project is 1,300 Riel/13,000 VND

Let us see another example:
Example 2: Player A contributes 300 Riel/3,000 VND, player B contributes 600 Riel/6,000 VND, player C contributes 0 Riel/0 VND and player D contributes 300 Riel/3,000 VND. Together there are 1,200 Riel/12,000 VND in the pot for the dike construction project. Now this amount is doubled to 2,400 Riel/24,000 VND. The 2400 Riel/24,000 VND are now divided in four equal shares of 600 Riel/6,000 VND and distributed to the players. After the round the players earned this:
Player A has 1,000/10,000 initial endowment minus 300/3,000 contributions plus 600/6,000 out of the project is: 1,300 Riel/13,000 VND; Player B has 1,000/10,000 initial endowment minus 600/6,000 contributions plus 600/6,000 out of the project is: 1,000 Riel/10,000 VND; Player C has 1,000/10,000 initial endowment minus 0 contributions plus 600/6,000 out of the project is: 1,600 Riel/16,000
Player D has 1,000/10,000 initial endowment minus 300/3,000 contributions plus 600/6,000 out of the project is: 1300 Riel/13,000 VND

One more example […]

Let us look how the game works in each round. Your decisions in this round will NOT count at the end. They are just for you to see how the game works. Exercise round: We start with the contribution of 1,000 Riel/10,000 VND to each player. Every player puts as much money into the envelope as he wants to contribute to the project. It is very important to clarify that nobody, except for the monitor, will be able to know the amount that each of you decides give or keep in the round. The only thing announced in public is the total amount of money, without knowing how each participant in your group contributed. And we will not tell anyone later. It is totally secret.
How is it played: In each round, you must decide how much money you want to contribute for the dike. The money you earn in each round depends on your decision and the decisions of the rest of the group, according to the explanation we gave you.
Steps to play in each round:
We will contribute the initial endowment now. Decide how much money you want to contribute to the project now. Put this amount into your envelope. I will go round to collect it.
Wait for the facilitator to calculate the total amount contributed. We will announce the TOTAL AMOUNT CONTRIBUTED, THE DOUBLED AMOUNT AND THE AMOUNT EACH OF YOU WILL RECEIVE OUT OF THE PROJECT. Then you receive your envelope back and the amount

each of you earned from the project. Let us play another round. Start all over again from the beginning.

Game starts

Let's start the game now. All the gains you receive from now on will be money you can take home. Now your decisions matter.

Each of you gets 1,000 Riel/10,000 VND per round as initial endowment. Now you have to decide how much money you would like contribute to the project. Please put the amount you want to contribute in the envelope and the rest into the box in front of you. _____ will go around collecting the envelopes.

[Behind the blind the researchers notes how much each player sent and put the money into the pot. This pot is then displayed and the money is counted in front of the group.]

You have altogether contributed _____ Riel/VND. This amount is doubled to _____ Riel/VND. Each one of you will get _____ Riel/VND out of the project.

[The amount is distributed in public to the players, as well as the envelopes are given back at the same time].

Please put the money in the box in front of you.

[After the 10 rounds are played]

Rule B: COMMUNICATION

Besides the rules described in the instructions that we just explained, there is an additional rule for the participants in this group from now on. The only change is that you are now allowed to talk for four minutes to each other. You can talk about anything you like including the game. After the four minutes have passed you are not allowed to communicate till the end of the round. You will take your own decision again in private and secret. The rest of the rules stay the same.

Now we start the game again. Please feel free to communicate. You have four minutes [The students will take notes on the communication]. [After four minutes] Now the time is up, please stop talking. You now have to decide, how much money you want to contribute to the project.

[After five rounds with communication]

Rule C: LEADERSHIP

Now there is another rule: There will be a group leader from now on. He /she will be chosen through a lottery. He is allowed to set a rule, how much you have to contribute. However, all other rules stay the same and your decisions will be made in private, so no one will know how much you contributed. You are still allowed to communicate for four minutes before each round before the leader sets a rule.

[Go around and let the players draw from a lottery]. Player number ___ has been chosen to be your leader. Now the time to communicate for the group starts. [The students will take notes on the communication.]. [After four minutes] The time is up now. Please stop talking again.

[To the leader] You can now talk to the other group members and announce the rule, how much the players have to contribute.

[To all] Now you have to decide, how much money you want to contribute to the project. Please put the amount you want to contribute in the envelope and the rest into the box in front of you. _____ will go round to collect the envelopes.

[Behind the blind the researchers note how much each player sent and put the money into a pot. This pot is then displayed and counted]

You have altogether contributed _____ Riel/VND. This amount is doubled to _____ Riel/VND. Each one of you will get _____ Riel/VND out of the project.

[The amount is distributed in public to the players, as well as the envelopes are given back at the same time]

Please put the money in the box in front of you.

[After the 20th round]

Now the game is over. Thank you!

Instruction for the CPR game

This exercise is similar to a situation in which a group of people has to make decisions on how to use a natural resource together. For this game, assume that you and three other villagers have to use one fish

pond together. Each of you can decide how many entities fish you want to take out of this water resource. So you have to decide about how many units of fish you want to make in one fish harvest, which is one round. The fish you gained in the game will be exchanged to money right after the session. The reason why we use a fish and a pond in this exercise is to represent real life situations in which your economic decisions will bring yourself monetary consequences. You will play several rounds equivalent to periods such as harvest rounds.

You can collect unit of fish in the box in front of you and at the end of the exercise; we will sum the total number of fish and give you money for it. We will personally hand that to you in cash. One unit of fish is equal to 100 Riel/1,000 VND.
To be able to play you will receive a box where you can store the fish from each round. [GIVE A BOX TO EVERYBODY], then you receive an envelope [GIVE AN ENVELOPE TO EVERYBODY]. This is used for exchanging GAME CARDS and FISH between us and you. We will explain this later.

Then you also receive GAME CARD like the one I am about to show you now. These are used to indicate the units of fish you want to extract from the resource. This amount of fish is equal to an amount in real money. In each round, we have one fish pond with 40 units of fish here in the middle of the room. Each round we start with 40 units in the pond and each of you has to decide how much of the fish you want to extract. This needs to be written down on a game card. You can write down 0 units of fish, 1, 2, 3 units of fish or 15, 16 and so on, how much you want. The game card is then handed in to us. This all happens in secret. Remember one unit of fish is equal to 100 Riel/1,000 VND, 2 units is 200 Riel/2,000 VND and so on.

It is very important that we keep in mind that the decisions are absolutely individual, that is, that the amount of fish you write down in the game cards are private and that you do not have to show them to the rest of the members of the group. I will collect the envelopes with the game cards from all participants, and will add the total of amount of fish the whole group decided to extract. Then I announce the group total. To know how much fish is left in the pond, we subtract the group total from 40 units. If there is fish left and only then, we will double the fish that is left in the pond. This amount will then be divided equally by all of you. At the end, you will get the fish you indicated in the game card plus the rest in the pond times two divided by four. However, if the group total of units is higher than 40 units it is not possible to extract any fish from the pond for any of you.

Let us explain this with an example. Each of you must decide in each round how much fish you want to take out of the pond. You give us your decision in secret and we add it up. For instance, “PLAYER A” decides to extract 20 units, “PLAYER B” six units, “PLAYER C” 10 units and “PLAYER D” zero units then the total of the group is 36 units of fish. [FACILITATOR: show poster with the EXAMPLE]. Remember in the pond were 40 units. Now we subtract the 36 units of the group from 40 units in the pond and have four units left. We will double this amount of fish and divide it by all members. In this example it is four units left, we double it to eight units and thus everybody receives two units of fish. At the end, you will have the units of fish you indicated in the Game Card plus two units we gave to you. Let’s see what every player gained: PLAYER A receives 22 units, PLAYER B 8 units, PLAYER C 12 units, PLAYER D 2 units

Let us look at another example in the poster. PLAYER A extracts 5 units, PLAYER B extracts 2 units, PLAYER C extracts 12 units, PLAYER D extracts 10 units. The group total is then 29 units. 40 minus 29 is 11. 11 times two is 22. 22 divided by four players is 5.5 units. So the individual gains are: PLAYER A receives 10.5 units, PLAYER B 7.5 units, PLAYER C 14.5 units, PLAYER D 15.5 units

There is one restriction. If the group total is more than 40 units of fish, then nobody will get anything. This means, the sum of units of fish each player can be over 40 and then nobody will get any unit of fish at all. Let’s see an example. PLAYER A extracts 3 units, PLAYER B extracts 18 units, PLAYER C extracts 22 units, PLAYER D extracts 15 units. The total of this round would be 58 units. Nobody will get any fish units in this round. You also will not get the units you wrote down.

Let us look how the game works in each round. We start with 40 units of fish in the pond. Every player writes down, how much fish he wants to take out of the pond. It is very important to clarify that nobody, except for the facilitator, will be able to know the number that each of you decides in each round. The only thing announced in public is the group total, without knowing how each participant in your group extracted. And I will not tell anyone later. It is totally secret.

Let us repeat the steps with a new example. [FACILITATOR: Repeat with the other two examples, writing the numbers in the posters hanging in the wall].
It is important repeating that your game decisions and earnings information is private. Nobody in your group or outside of it will be able to know how many points you earned or your decisions during rounds. We hope these examples help you understand how the game works, and how to make your decisions to allocate your units in each round of the game. If at this moment you have any question about how to earn fish in the game, please raise your hand and let us know.
It is very important that while we explain the rules of the game you do not engage in conversations with other people in your group. If there are no further questions about the game, then we will assign the numbers for the players and the rest of forms needed to play.

Preparing for playing:
Now write down your player number in the GAME CARD. In the following poster we summarise for you the steps to follow to play in each round. Please raise your hand if you have a question.
Finally, to get ready to play the game, please let us know if you have difficulties reading or writing numbers and one of the facilitators will sit next to you and assist you with these. Also, please keep in mind that from now on no conversation or statements should be made by you during the game unless you are allowed to. We will have first a few rounds of practice that will NOT count for the real earnings, just for your practicing of the game.

Example round
The objective of the game is to get as much fish as possible at the end of the rounds. This will then be converted into cash for your HH.
How is it played: In each round, you must decide how many units you want to extract from the common water resource. The points you earn in each round depend on your decision and the decisions by the rest of the group, according to the explanation we gave you.
Steps to play in each round:
Using the GAME CARD, decide how many UNITS you will play. Hand in the game card to me.
Wait for the facilitator to calculate the total from all the cards in the group. We will announce the TOTAL GROUP UNITS, THE AMOUNT OF FISH UNITS LEFT IN THE POND AND THE AMOUNT DOUBLED AND THEN DIVIDED BY ALL MEMBERS.
Then you receive your units of fish earned in the round by you. This is the fish you extracted, plus the additional fish you get from the fish that was left in the pond.
Let us play another round. Start all over again from the beginning.
Let's start the game now. All the gains you receive from now on will be exchanged to real money, which you can take home. Now your decisions matter.
PLEASE REMEMBER, THERE IS THE Rule that THERE IS NO COMMUNICATION WITHIN THE GROUP. Please do not make any comment to another participant or to the group in general.

[FOR TEN ROUNDS]
Now you have to decide how much fish you want to extract. Please write the amount of units on the card. I will go around collecting the cards. [Behind the blind the researchers note how much each player extracts and announces the group total]. You have altogether extracted _____ units. In the pond were 40 units. 40 units minus _____ units is _____ units, which are left in the pond. This amount is doubled to _____ units. Each one of you will get _____ units from the fish units left. [The cards indicating the gained units is distributed in public to the players, as well as the envelopes with the fish cards]
Please put the fish in the box in front of you. You will hand this in later.
[After the 10 rounds]

Rule B: MONITORING OF MEMBERS
Besides the rules described in the instructions that we just explained, there is an additional rule for the participants in this group from now on. This new rule is for ensuring to obtain the maximum fish possible for the group. Let us try to guarantee that each player in your group does not extract any of the fish, meaning all players extract zero units. The decisions will still be private and individuals do not know how much other players extracted. If a player still wants to extract fish we will impose a penalty. However, it would be very difficult to inspect the members of a community all the time. Thus, after each round we will throw a dice, which everybody can see. Whenever the number six appears on the dice, we will monitor the whole group. This means, there is a one to six chance that the whole group is monitored. Every player who extracted fish then, must give it back and additionally has to pay a penalty of four units of fish. The rest of the rules stay the same.
[SHOW WITH EXAMPLE]
Let's start
[FOR FIVE ROUNDS]
Now you have to decide again how much fish you want to extract. Please write the amount of units on the card. I will go around collecting the envelopes. [Behind the blind the researchers note how much each player extracts and announces the group total] You have altogether extracted _____ units. In the pond were 40 units. 40 units minus _____ units is _____ units, which are left in the pond. This amount is doubled to _____ units. Each one of you will get _____ units from the fish units left.

Now, we will throw the dices.
If six appears: Everybody will be monitored. If you extracted fish, you will not get it, but you will get a fine for not following the rule. And you will also not get any shares from the common pond. Everybody who played according to the rule will get the fish from the common pond and no fine.
If one to five appear: nothing happens and we pay back all fish earned in this round.
[The cards indicating the gained units is distributed in public to the players, as well as the envelopes with the game cards]
Please put the cards in the box in front of you. You will hand this in later.
[After 20th round]
The game is over now.
Player 1 please come behind the blind, take your box and envelope, so we can change it into real money. Proceed with player 2 to 4.

Instruction for the Trust Game
This game is played by pairs of individuals. Each pair is made up of one player out of group A and one player out of group B. Each of you will play this game with someone from your own village. However, none of you will know exactly with whom you are playing. Only [*insert name of researcher*] knows who is to play with whom and [*he/she*] will never tell anyone else. So player 1 of group A will not necessarily play together with player 1 of group B or player 6 of group A will not necessarily play together with player 6 of group B.

[*Insert name of* researcher] will give 4,000 Riel to each player in group A and another 4,000 to each player in group B. The player in group A then has the opportunity to give a portion of their 4,000 Riel to a player from group B.[272]

They could give 4,000 Riel, or 3,000 Riel, or 2,000 Riel, or 1,000 Riel, or nothing to the player of group B. If player of group A sends 4,000, he will keep nothing, if he sends 3,000 he will keep 1,000 if sending 2,000 player of group a will keep 2,000 if player of group A sends 1,000 he will keep 3,000 and if he sends nothing he will keep 4,000 Riel.

[272] Note that this instruction only involves the amounts in Riel in order to facilitate reading. The equivalent amounts in VND are the amount in Riel times 10 (e.g. the initial endowment in Vietnam was 40,000 VND).

Whatever amount the player in group A decides to give to the player in group B will be tripled by the researcher before it is passed on to the player of group B. The player of group B then has the amount passed plus the initial 4,000 Riel player of group B then has the option of returning any portion of this amount to the player of group B. Then, the game is over. There will not be another round.

Player of group A goes home with whatever he or she kept from their original 4,000 Riel, plus anything returned to them by player of group B. Player of group B goes home with their original 4,000 Riel, plus whatever was given to them by player of group A and then tripled by [*insert name of researcher*], minus whatever they returned to player of group A.

Here are some examples. During the game you can decide on your own, what amount of money you would like to send:

1. Imagine that player of group A gives 4,000 Riel to player 2. [*Insert name of researcher*] triples this amount, so player 2 gets 12,000 Riel (3 times 4,000 Riel equals 12,000 Riel) in addition to their initial 4,000 Riel. At this point, player 1 has nothing and player 2 has 16,000 Riel. Then player 2 has to decide whether they wish to give anything back to player 1, and if so, how much. Suppose player 2 decides to return 3,000 Riel to player 1. At the end of the game, player 1 will go home with 3,000 Riel and player 2 will go home with 13,000 Riel.

2. Now let's try another example. Imagine that player 1 gives 3,000 Riel to player 2. [*Insert name of researcher*] triples this amount, so player 2 gets 9,000 Riel (3 times 3,000 equals 9,000 Riel) in addition to their initial 4,000 Riel. At this point, player 1 has 1,000 Riel and player 2 has 13,000 Riel. Then player 2 has to decide whether they wish to give anything back to player 1, and if so, how much. Suppose player 2 decides to return 8,000 Riel to player 1. At the end of the game player 1 will go home with 1,000 Riel and player 2 will go home with 13,000.

More examples…..
Optional more examples

Note that the larger the amount that player 1 gives to player 2, the greater the amount that can be taken away by the two players together. However, it is entirely up to player 2 to decide what he should give back to player 1. The first player could end up with more than 4,000 Riel or less than 4,000 Riel as a result.

Now, I want you work these examples through with me:
11. Imagine that player 1 gives 3,000 Riel to player 2. So, player 2 gets 9,000 Riel (3 times 3,000 Riel equals 9,000 Riel) in addition to their initial 4,000 Riel. At this point, player 1 has 1,000 Riel and player 2 has 13,000 Riel. Suppose player 2 decides to return 5,000 to player 1. At the end of the game player 1 will have how much? [*the initial 4,000 Riel-3,000 Riel (given to player 2) =1,000 Riel+ return from player 2 of 5,000 Riel= 6,000 Riel. If they are finding it difficult, talk through the math with them and be sure to use demonstration with the actual money*]. And player 2 will have how much? [*Their original 4,000 Riel+9,000 Riel (after the tripling of the 3,000 Riel sent by player 1)- 5,000 Riel they return to player 1=8,000 Riel, if they are finding it difficult, talk through the math with them*].

12. Imagine that player 1 gives 1,000 Riel to player 2. So player 2 gets 3,000 Riel (3 times 1,000 Riel equals 3,000 Riel) in addition to their initial 4,000 Riel. Then, suppose that player 2 decides to give 1,000 Riel back to player 1. At the end of the game player 1 will have how much? [*The initial 4,000 Riel-1,000 Riel (given to player 2) =3,000 Riel +return from player 2 of 1,000 Riel=4,000 Riel. If they are finding it difficult, talk through the maths with them and be sure to use demonstration with the actual money*]. And player 2 will have how much? [*Their original 4,000 Riel +6,000 Riel (after the tripling of the 3,000 Riel sent by player 1)-1,000 Riel they return to player 1= 6,000 Riel, if they are finding it difficult, talk through the maths with them*].

We can go through more examples with each of you individually when you come to play the game if you did not understand the game completely. In the meantime, do not talk to anyone about the game. Even if you are not sure that you understand the game, do not talk to anyone about it. This is important. If you talk to anyone about the game while you are waiting to play, we must disqualify you from playing.

[*Note to researcher: The researcher and the research assistant leave to another room, where the decisions are made. You can begin to call player 1's one after the other.*]

First player: You are player 1. Here are your 4,000 Riel. [*At this point 4,000 Riel is placed on the table in front of the player*.] Now, you must hand to [*insert researcher's name*] the amount of money you want to be tripled and passed on to player 2. You can give player 2 nothing, 1,000 Riel, 2,000 Riel, 3,000 Riel, or 4,000 Riel. player 2 will receive this amount tripled by me plus their own initial 4,000 Riel. Remember the more you give to player 2 the greater the amount of money at his or her disposal. While player 2 is under no obligation to give anything back, we will pass onto you whatever he or she decides to return. Please go back to your room and do not talk to the other players.

[*Note to researcher: Finish all player 1's and send them to a third holding location - they must not return to the group of player 1's who have not played and they must not join the player 2's. Once all player 1's have played you can begin to call player 2's. Player 2's can be paid off immediately after they play.*]

Second player: You are player 2. First, here are your 4,000 Riel. [*Put the 4,000 Riel in front of player 2.*] Let's put that to one side. [*Move the 4,000 Riel to one side but leave it on the table.*] This pile represents player 1's initial 4,000 Riel. [*Put this 4,000 Riel in front of the researcher.*] Now [*insert name of researcher*] will show you how much player 1 decided to give to you. It will be tripled. So you have the amount of [*insert amount player 2 receives*] Riel and player of group A has [*insert amount player 1 kept*] Riel. Now, please give the amount of money you want to send back to [*insert name of researcher*]. Remember, you can choose to give something back or not. Do what you wish. [*Now the player hands back his return for player 1.*] Please go back to your room and do not talk to the other players.

[*Note to researcher: Finish all player 2's and send them back to their room - they must not talk to the other player 2's. Once all player 2's have played you can begin to call player 1's again to hand them out the returns.*]

First player: You sent the amount of [*Insert amount sent by the player*] Riel to player B. Here is the amount player B returned to you. [*At this point the amount sent from player 2 is placed on the table in front of player 1*.]

Post Game Questionnaires PG and CPR game

Village: _____

Player Number: _____ Turn: _____

Respondent's NAME:_____

Name of HH head: _____

General information

Did your HH participate in the baseline survey in November?

How much cultivation land does your HH have and how many times do you crop per year:

Cultivation land: _____
Amount of crops: _____

What are your main income sources?
Rice cultivation ☐
Gardening (Fruits/Vegetables) ☐
Fishing ☐
Small business ☐
Wage Labour ☐
Remittance Labour ☐

Please give us some details about your housing situation:

House details	Answer
Total living space area (m2)	
Total homestead area (m2)	
Main roof material	
Main wall material	
Main floor material	
Main light source	
Main toilet-type	
Main drinking water source	
Main cooking Fuel	

General Impression
What do you think of this experiment / experience? (*crazy … just money falling from the sky → realistic … recognizable problems*)

Did you enjoy it? If yes - why? If no- why not?

Did you understand everything?
Yes ☐
No ☐
Don't know ☐

What did you not understand?

How difficult was the game to play?
Fun ☐
Easy ☐
Frustrating ☐
Difficult ☐
Confusing ☐
Other ☐
Comments _____

Did you learn something during the game?
Yes ☐
Quite a lot ☐
A bit ☐
Not really ☐
Not at all ☐
Comments_____

What did you learn?

Did you learn something about natural resource management? Can you describe it?

Do you think it is a good game to learn something about natural resources? If yes-why? If not-why not?

Would you like to play it again? If yes-why? If not-why not?

Would you recommend others to play it? If yes-why? If not-why not?

Which of the different rounds did you like best? Why?

Real Life Application
Did the game you participated in remind you of decisions situations you know/ encountered so far in real life? If yes – which ones? Why? Please describe?
If no or only little - what were the differences? (e.g. to the situations mentioned in the examples explaining the games)

Sending Motives
Why did you extracted / contributed the way you did [*allocation example*]?
(e.g. *selfish, according to middle, altruistic*)

Are you satisfied with your decisions or would you decide/play differently if you could play again?

How much do you think most other people extracted / contributed?

What do you think is the best amount of units to extract / contribute? And why?

Personal Impact of the Game
What are you planning to do with the gain?

When? (immediately – later)

Are you going to share with somebody? With whom?

Natural resource management

How is the status of the natural resources in the village?

Excellent ☐
Good ☐
Ok ☐
Bad ☐
Very bad ☐
Don't know ☐

Does the village face any problems with natural resources? If yes, which ones?

Do these problems affect you and your HH? If yes, in which way?

Do you think it is important to protect the natural resources in your commune? If yes, Why? If no, why not?

Who is, in your opinion, responsible to protect the natural resources in your village? Why?

Government ☐
Villagers ☐
Community ☐
All together ☐
Others _____ ☐

Do you think, your decisions on how to use natural resources influence the decisions of others? If yes, how? If no, why not?

Do you think one person alone can influence the condition of the resources?
Yes ☐
No ☐
Don't know ☐

Who can influence the condition of natural resources?
Individual ☐
Individual only ☐
Community/Group ☐
Community/Group only ☐
Government ☐
Government only ☐
Nature (e.g. weather) ☐
Nature only ☐
Comments:

Institutional Membership
Are you a member of any group which organises collective activities? These may be formal (i.e. farming society, NGO group, co-operative, fishing society, religious society, political party) or informal (i.e. rotating micro-credit group, shared labour groups).

Type of group or organisation	N° years involved	N° meetings attended last 12 months	**Member Type**	**Principle activities last 12 months**

Why are you a member? Why not?

In the last 12 month, did you or one of your HH members participate in work for the community (no paid work; e.g. street repairing, school construction, funeral)?

Please list the activities, how much time it took, how many people took part from the village and if you contributed money. Did you take part voluntarily?

Activity	Time	Money (Amount)	People	Voluntary / forced

Should there be more common activities being organised in your village? Why?

Pre Game Questionnaires Trust Game
You decided to play the game with us. First we want you to answer some questions. The answers are confidential. Thank you for taking part in the game!

Date: _____ Name of Interviewer: _____ Village: _____

Individual's Name: _____ Player Group: _____ Player Number: _____
HH Name: _____

Birth Year	
Sex (M/F)	
Education in Years (r = can read and write)	
HH Head (h=head, s = Spouse of Head, n = neither)	
Current Marital Status (M=Married, D=Divorced, W=Widowed, S=Single)	
Number of Offspring	
Size of HH (Number of people living in your house)	
Village	
Number of Years Living in this Village	

Question: We want to know all of the cooperative activities you have participated in this year with other persons [sibs, half sibs, parents and grandparents do not count, uncles and cousins do].

Cooperative Activities E.g. (Well Digging, street repairing, school building, transplant, cow sharing, ceremonies, weddings or funerals …)	Did You Participate This Year? (Y/N)	Did the Activity Improved your well-being? (Yes, No)	IF YOU PARTICIPATED	
			Number of People Involved	Time spent for the activity

Question: Are you member in any local or regional organisation (e.g. farmer association, a co-operative union or a political party, etc.)? Yes ___ No _____ If yes, how many? _____

Question: Do you have responsibilities in this organisation? Yes ___ No ____

Question: Please list everything that was eaten by everyone in your HH yesterday.

Food Types Consumed Yesterday Grains (Specify), Pasta, Gruel, Meat (Specify)/Fish, Milk, Vegetables (Specify), Fruits, (Specify), Sauces, Cooking Oil, Sugar, Tea/Coffee, Beer, Processed Foods, Purchased Meals, Other (Specify)	Source of Food (Check One Only)		
	Purchased	From Home	Gift to the HH

Question: What are your main income sources?

Income source		Frequency (w = weekly, m = monthly, y = yearly)	Amount per period
Rice cultivation	☐		
Fruit / Vegetable cultivation	☐		
Fishing	☐		
Small Business	☐		
Wage Labour	☐		
Other: _____	☐		
Don't know	☐		

Question: How many days this have you worked in wage labour of any sort in the past month: ____
Question: If you are not currently doing wage labour, have you ever done it in the past? Yes _ No _
If so, when was the last time you did wage work? Write the Year: _____

Question: How many times have you engaged in trading goods for profit, that is buying with the intent to resell goods (such as livestock), in the last month? _____

Question: How many days out of the last 7 has this individual personally made a trip to a market, to buy or sell anything? _____

Question: Do you feel that the other villagers have a higher, the same or lower income?
Higher ☐
Same ☐
Lower ☐

Don't know ☐

Question: Do you have a permanent home?
Yes ☐
No ☐

Don't know ☐

Question: Is this home
Owned and completely paid for? ☐
Owned with a mortgage? ☐
Rented? ☐
Other (specify)? ☐ _____

Question: Do you have means of transportation?
Yes ☐
No ☐

Question: What kind of transportation?
Bicycle ☐
Ox cart ☐
Motorbike ☐
Car ☐
Other (specify) ☐ _____

Question: Do you own domestic land?
Yes ☐
No ☐

Don't know ☐

Question: Is that land
Owned and completely paid for? ☐
Owned with a mortgage? ☐
Other (specify)? ☐ _____

Question: How large is it? _____

Question: Do you own agricultural land?
Yes ☐
No ☐

Don't know ☐

Question: Is that land
Owned and completely paid for? ☐
Owned with a mortgage? ☐
Other (specify)? ☐ _____

Question: How large is it? _____

Post Game Questionnaires Trust Game

General Impression
What do you think of this experiment?
(*crazy … just money falling from the sky → realistic … recognizable problems*)

_____

Did you enjoy it? Yes / No

If yes - why? _____

If no - why not? _____

Did you understand everything? _____

Real Life Application
Did the game remind you of decisions situations you know in real life? Yes / No

If yes – which ones? _____

Why? Please describe? _____

Sending Motives
Why did you decide the way you did? (e.g. *selfish, according to middle, altruistic*)

_____

Are you satisfied with your decisions or would you decide/play differently if you could play again?
_____

Only for player A:
There are five boxes below. By putting a tick mark in any of the boxes you can indicate why you sent money. You may put tick marks in more than one box.

you think it would be unfair not to send anything.	☐
you think the receiver probably needs this money more than you do	☐
you believe that you will get punished during your lifetime, if you are not generous to others.	☐
you believe that you will get punished either after your lifetime, if you are not generous to others.	☐
you believe that you will gain from sending the money	☐

Only for player B:
There are three boxes below. By putting a tick mark in any of the boxes you can indicate why you sent back money. You may put tick marks in more than one box. You can put tick marks in any of the boxes even if you did not send back any money.

you think it would be unfair not to send anything back	☐
you think the sender probably needs this money more than you do.	☐
you believe that you will get punished during your lifetime, if you are not generous to others.	☐
you believe that you will get punished, after your lifetime, if you are not generous to others.	☐

For all Payers:
How often in the last year, did you lend a small amount of money to friends and neighbours? [enough to pay for expenses for your HH for one week]

once a year or less	☐

about once every other month	☐
about once a month	☐
about once a week	☐
more than once a week	☐

How important is your religion for your daily life? How much do religious beliefs influence your everyday life?

Extremely important	☐
Very important	☐
important	☐
Not very important	☐
not important	☐

In the past 12 months, have you been a victim of a crime?

Yes	☐
No	☐

How much do you think most other people would give? _____
_____

Only for player A: How would you feel if you received a very low amount back? (e.g. would care, unlucky, happy, angry, sad, fearful, hatred, etc.)

_____

Only for player B: How would you feel if you received a very low offer from the other player (e.g. would care, unlucky, happy, angry, sad, fearful, hatred, etc.)

_____

Personal Impact of the game
What are you planning to do with the gain? _____
_____
When? (e.g. immediately, later, save) _____

Are you going to share with somebody? Yes / No
With whom? _____

SECTION C
Poverty Indicators

Indicator	Middle	Poor
Land	1-3 ha; orchard for crops (0.5-1 ha)	0-1 ha; no orchard land for cultivation
House	zinc and tile	small, leaf roof
Livestock endowment	2-3 cows/ Buffalos, pigs, chickens and ducks	0-1 cows/ buffalo
Assets	Transportation such as moto, bike	No transportation such as moto or bike
Occupation/Education	Additional occupation besides farming such as small business, selling labour, fishing, etc.; higher education of family members	No own business according to a lack of capital; lower education of all family members
Family size	4-5	6-10

Table 19: Poverty indicators PE village (Source: CCK)

Indicator	Very poor	Ranking
Agricultural Labour	Lack of cow/buffalo	2
Housing	Leaf roof	7
Land	0,5 ha -30 A	3
Transportation	Bike	6
Diseases		4
Debts	Long-term interest	5
Drought		1

Table 20: Poverty indicators and ranking in TK village

Indicator	Better-off	Middle	Poor	Ranking
Cultivation land	> 3 ha	3 -0.5 ha	<0.5 ha	1
Income	>800.000 VND/month/pp	800.000-300.000 VND/month/pp	< 300.000 VND/month/pp	2

Table 21: Poverty indicators in E2 hamlet

Indicator	Better-off	Middle	Poor	Ranking
Cultivation land	> 1.5 ha	1.5-0.5 ha	0.5-0.0	1
Income	> 500.000 VND/month/pp	500.000-200.000 VND/month/pp	< 200.000 VND/month/pp	2

Table 22: Poverty indicators in TPB hamlet

Resource maps developed by villagers

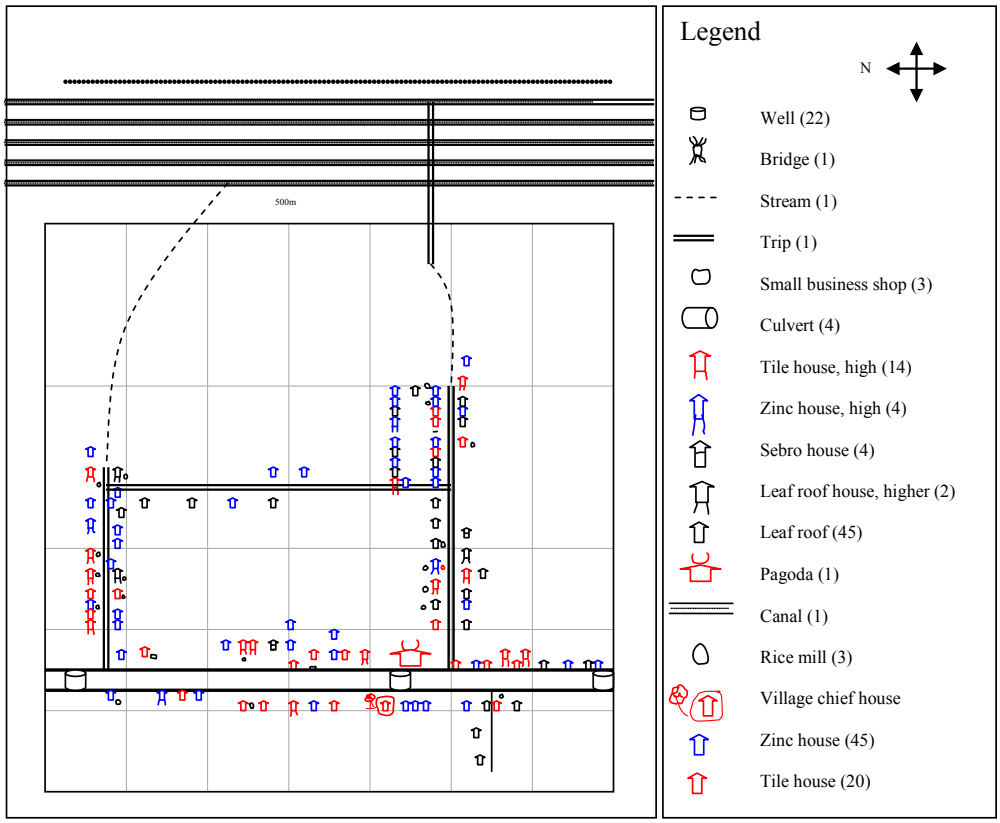

Figure 53: Resource map PE village (Source: CCK Report)

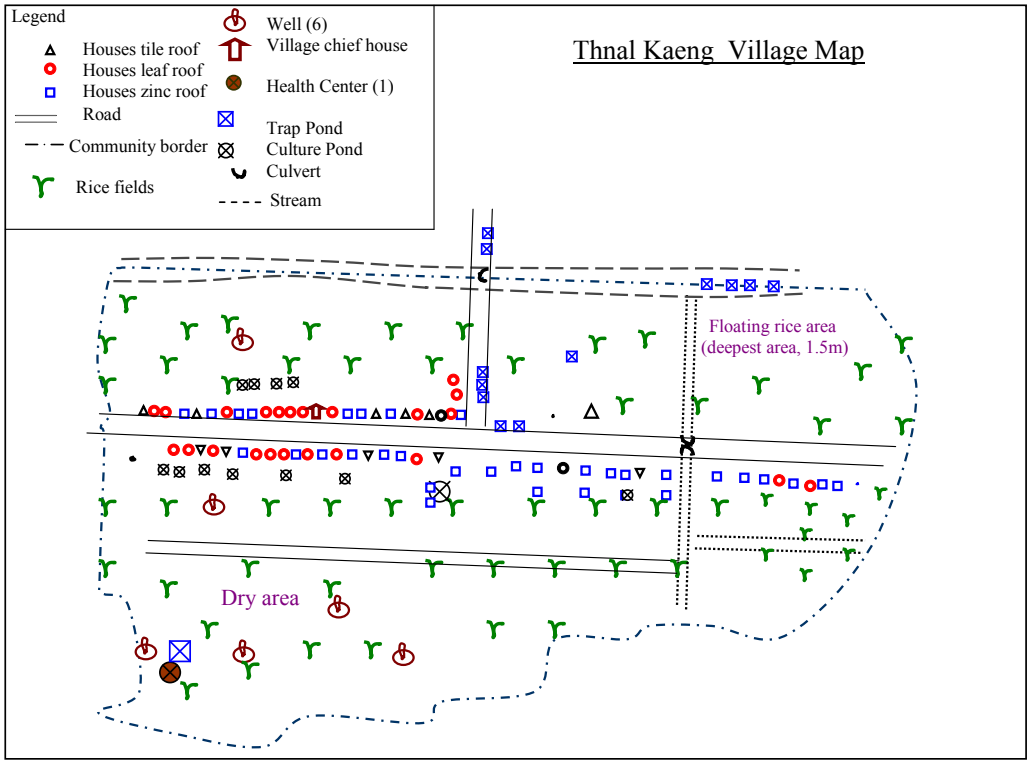

Figure 54: Resource map TK village (Source CARE International)

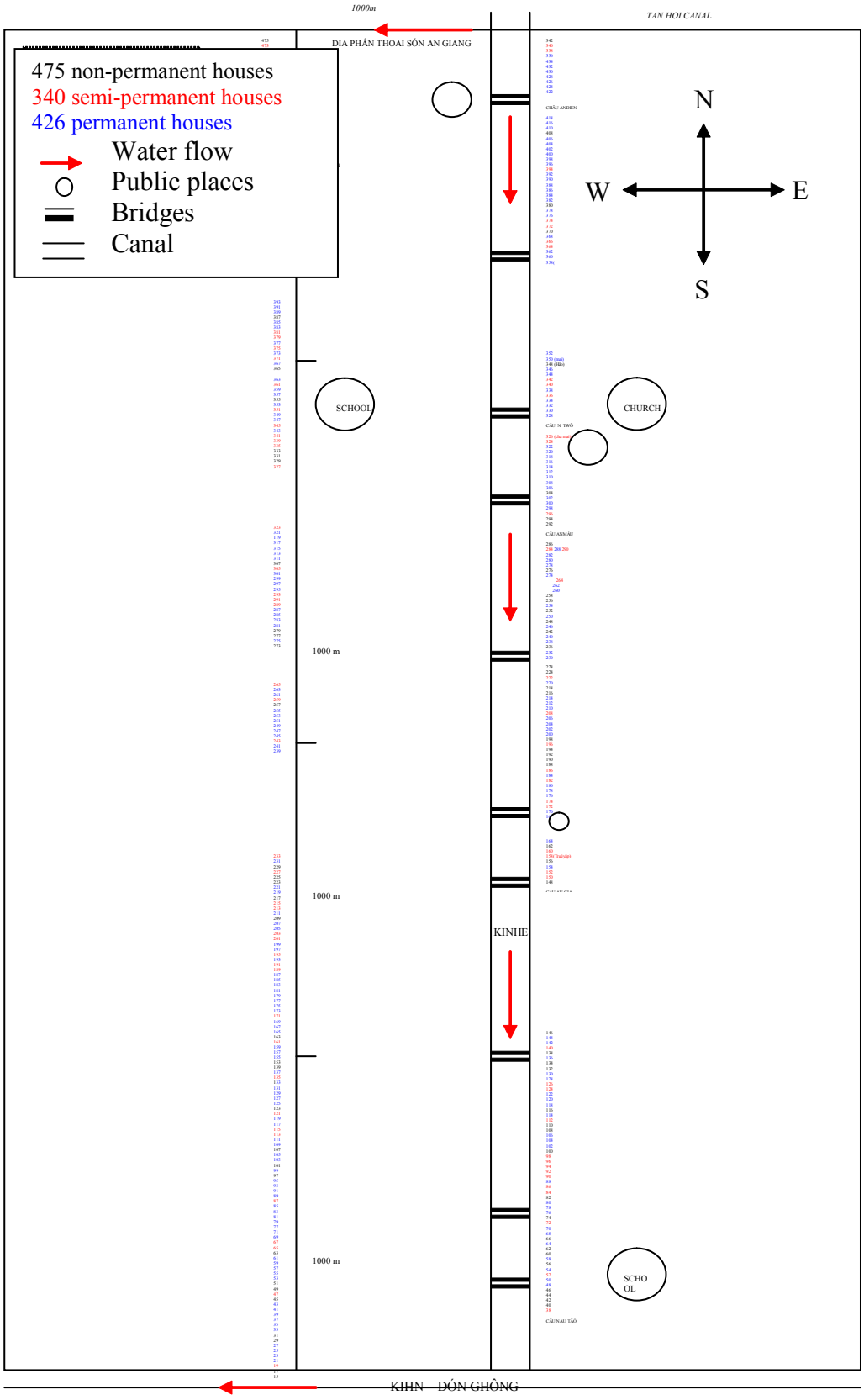

Figure 55: Resource map E2 hamlet (drawn by a group of villagers 2007)

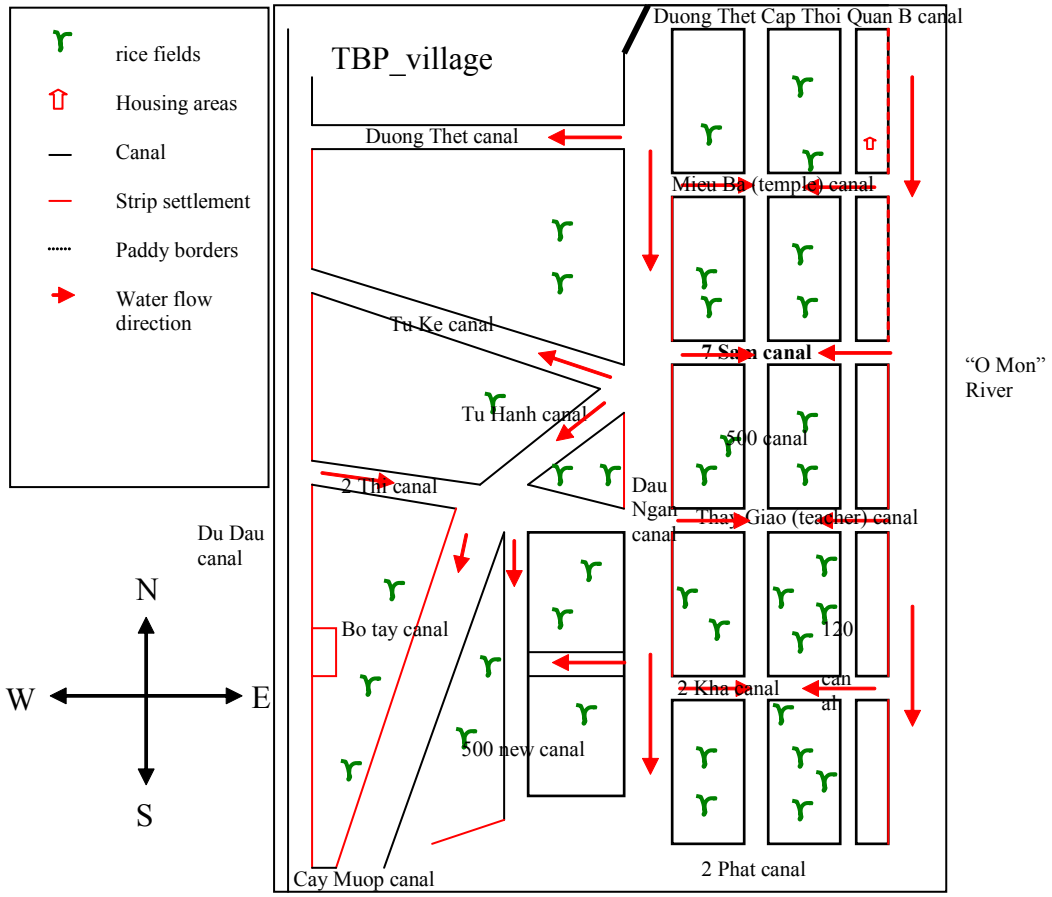

Figure 56: Resource map TPB hamlet (drawn by a group of villagers in 2007)

Google Images of the villages

Figure 57: Location of PE village (Cambodia) at Tunloab Reservoir, also indicating the border to Vietnam (yellow line) (Source: Google Maps 2009)

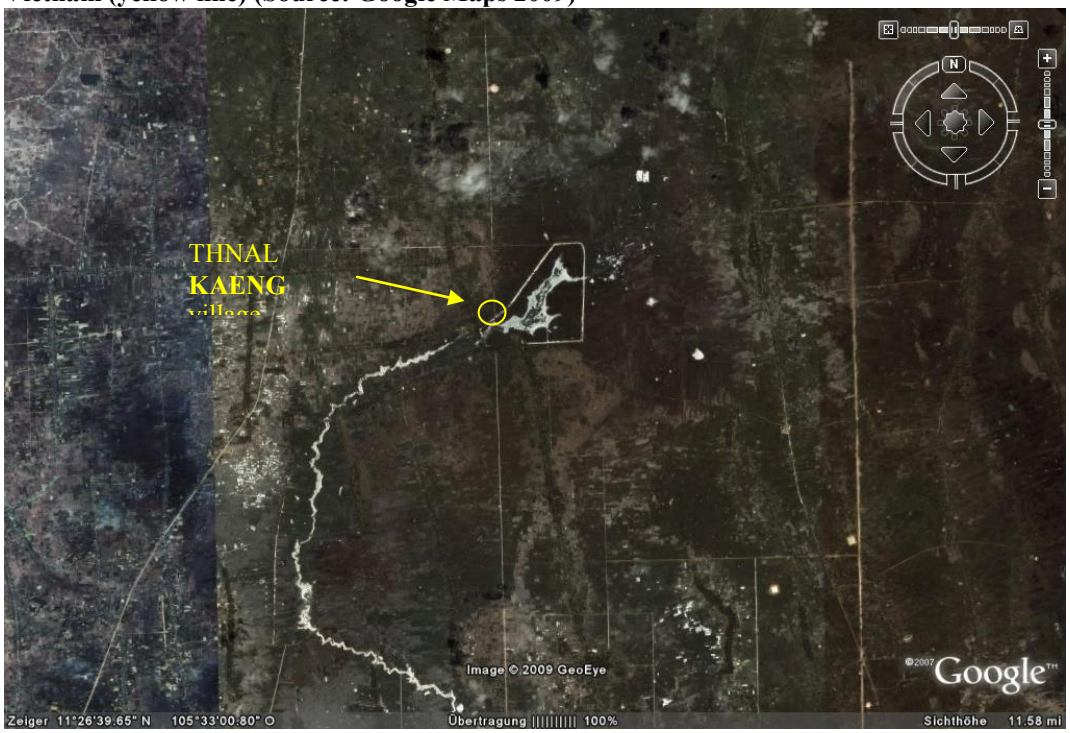

Figure 58: Location of TK village (Cambodia) at Boeng Khei Reservoir (Source: Google Maps; October 2009)

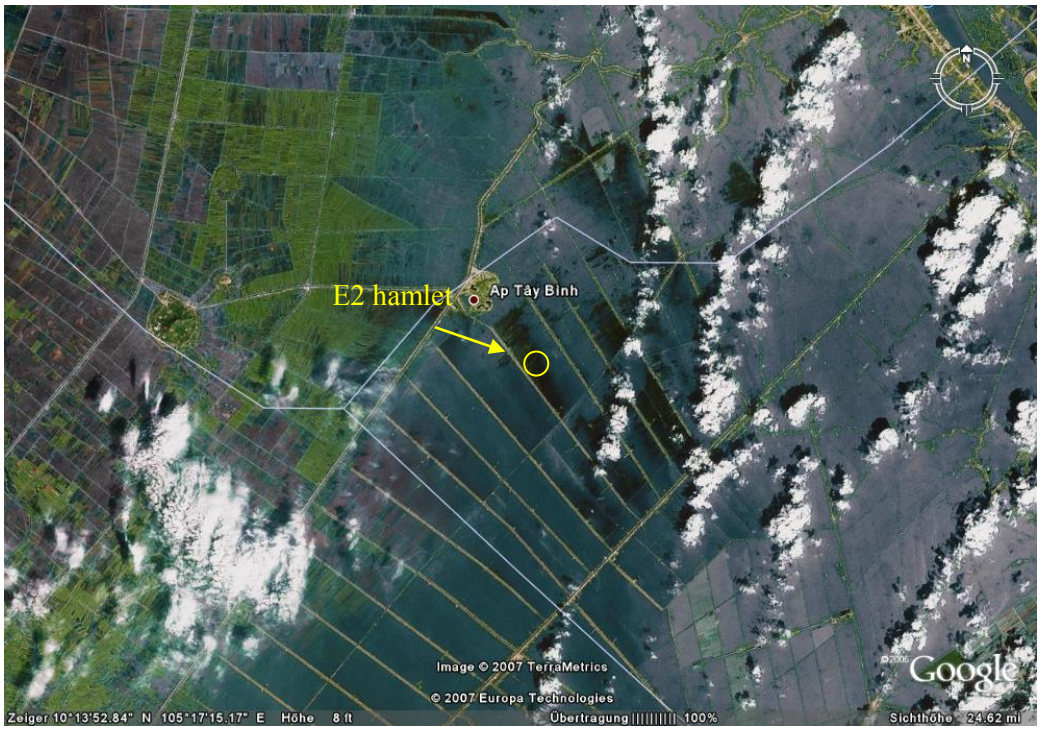

Figure 59: Location of E2 hamlet (Vietnam) with highly developed canal system (Source: Google Maps; Oct. 2009)

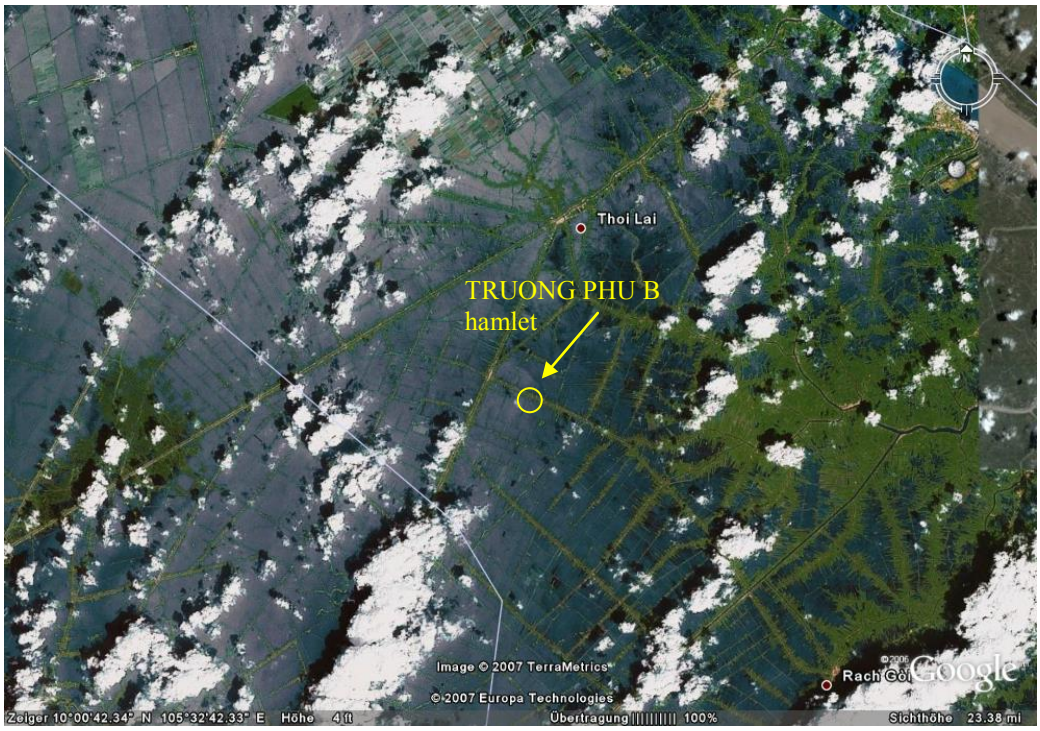

Figure 60: Location of TPB hamlet (Vietnam) with highly developed canal system (Source: Google Maps; October 2009)

Seasonal Calendars

Month	Wet Season	Dry Season	Flood	Livestock raising	Banana growing	Fishing	Potato culture	Corn culture	Rice culture	Bean culture
Jan				Duck raising for eggs during whole year.		The abundance of fish depends on the months, but fishing is conducted during the whole year.			Harvest	
Feb										
Mar										
Apr										
May									Wet season rice cultivation	
June										
July										
Aug										
Sept										
Oct										
Nov										
Dec									Wet season rice harvest day	

Figure 61: Seasonal calendar PE village (Source: CCK)

Activity\month	1	2	3	4	5	6	7	8	9	10	11	12
Land cultivation	++	+	+++	++	+	+	+++	+	+	+	+	++
Livestock raising	+	+	+	+	+	+	+	+	+	+	+	+
Fishing									+	+	+	
Fish culture			++	+++								
Festivals			+									+

Figure 62: Seasonal calendar of E2 hamlet

Activities TPB	1	2	3	4	5	6	7	8	9	10	11	12
Rice farming	+++	+++	++	++	++	+++	++	+		+++	+++	+++
Cash cropping (vegetables, beans, potatoes)	+++	++	+	+				+++	+++	+++	+++	++
Fish culture						+	+	++	+++	+++		
Fishing	+	+	+	+	+	+	+	+	++	+++	+	+
Livestock raising (chicken, pigs, ducks, cows)	+	+	+	+	+	+	+	+	+	+	+	+
Labour (rice cropping or remittance)	+++	+++	++	++	++	+++	++	+	+	+++	+++	+++
Festivals, holidays		+++										

Figure 63: Seasonal calendar of TPB hamlet

Main waterbodies of the four villages

Country	Village	Waterbody
Cambodia	*Pom Eith*	Preak Tonloab reservoir
	Thnal Kaeng	Boeng Khei reservoir
Vietnam	*Truong Phu B*	Distribution canals in the Long Xuyen Quadrangle Area
	E2	

Table 23: Main waterbodies of the research villages

Distribution of benefits

Disposition of benefits	Suggestions villagers PE	Suggestion authorities	Final agreement	Disposition of benefits	Suggestions villagers TK	Suggestion authorities	Final agreement
Savings	30	30	30	Savings	-	50	15
Poor people (elders and children)	5	5	5	Community	10	5	10
Fish culture group	40	55	50	Poor people (elders and orphans)	5	-	-
Salary permanent labourer	-	10	-	Fish culture group	70	30	60
Ceremonies	10	-	-	Administration	-	5	5
Authorities	10	-	-	Committee/Authorit.	-	10	10
Compensation for paddy field owners in fencing area	5	-	5	Ceremonies	10	-	-

Table 24: Distribution of benefits in PE and TK in percent

Survey Data

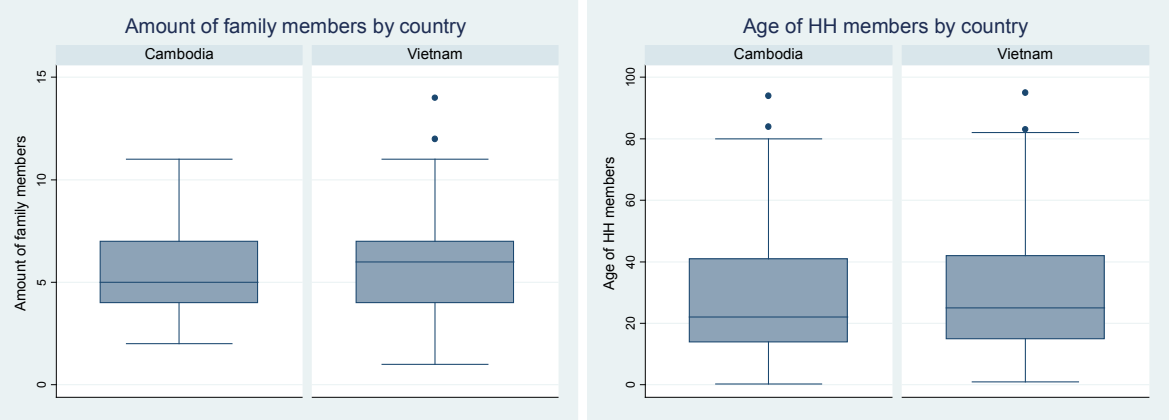

Figure 64: Box plot of family size and age by country

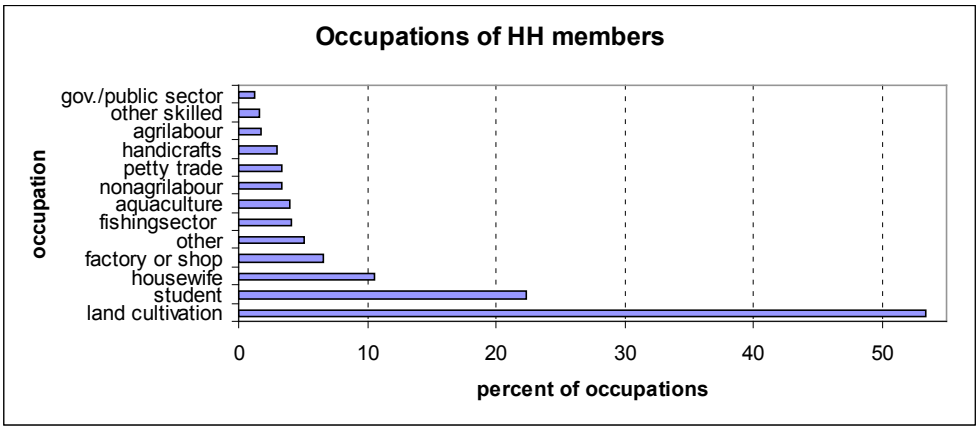

Figure 65: Occupations of HH members in percent (n=1113)

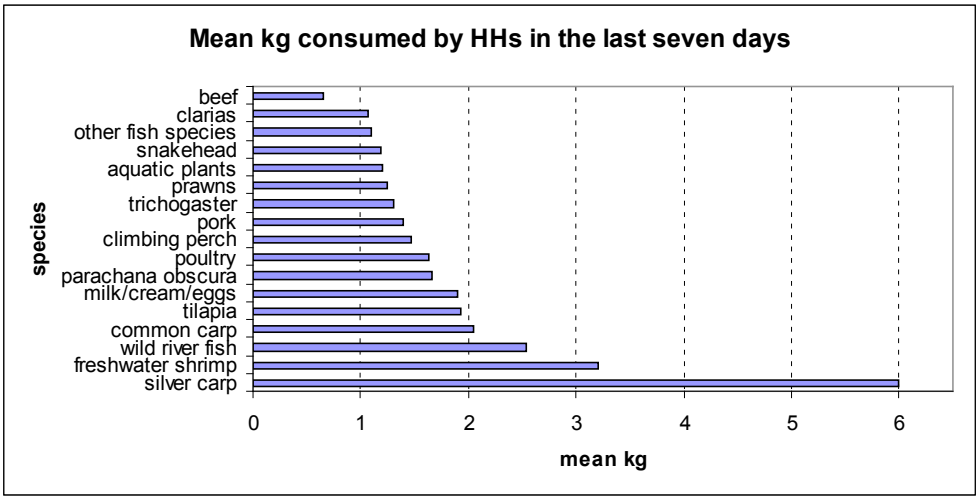

Figure 66: Mean kg consumed by HHs in the last seven days (n=1006)

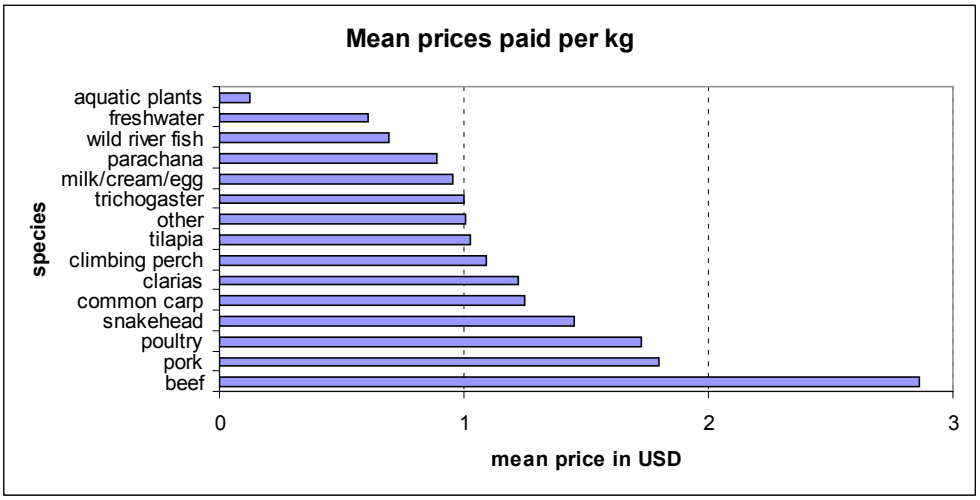

Figure 67: Mean price in US$ paid per kg (n=774)[273]

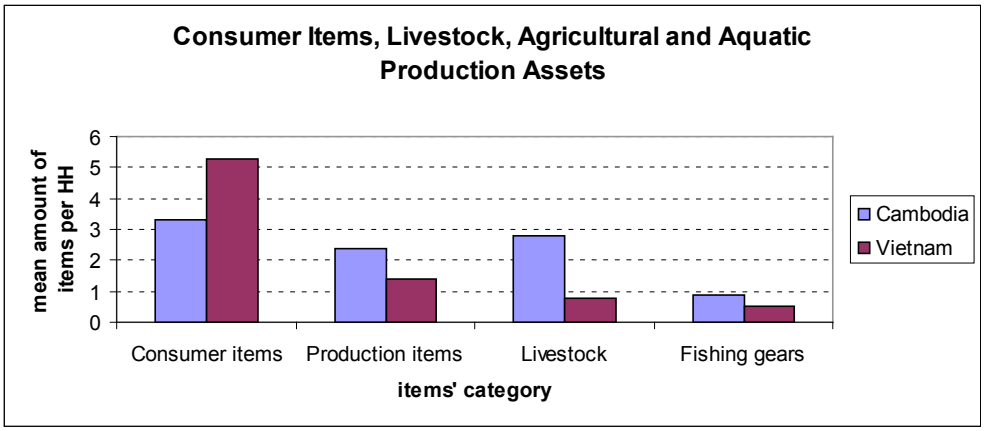

Figure 68: Consumer items, livestock, agricultural and aquatic production assets by country

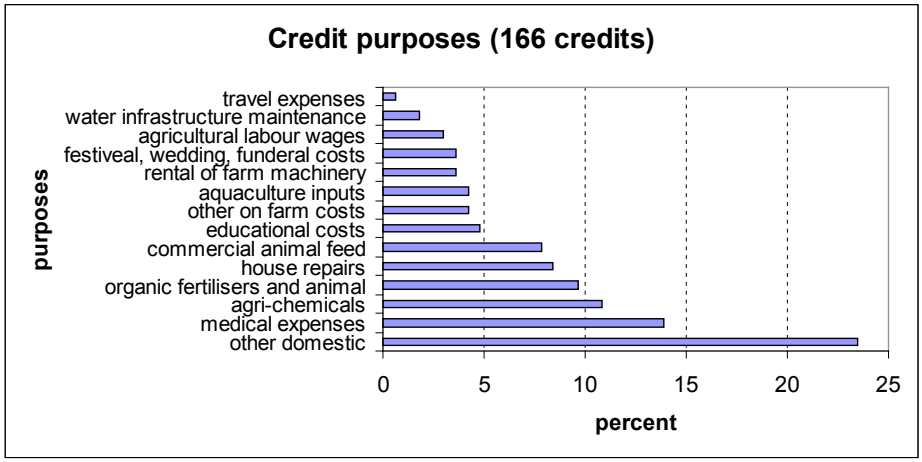

Figure 69: Credit purposes in percent of all credits taken (n=166)

[273] For silver carp, of which the most is consumed on average, no prices are available. This leads to the assumption that those are caught by the families rather than purchased.

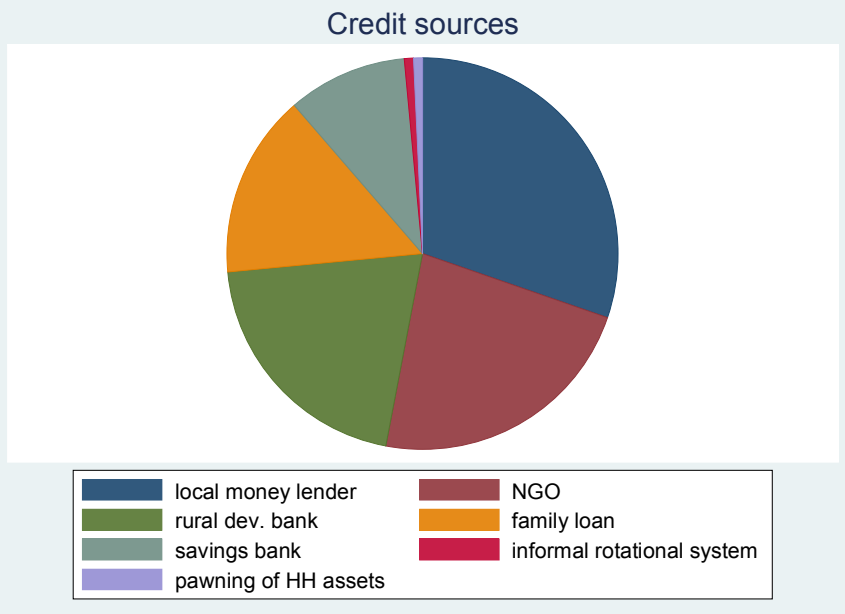

Figure 70: Credit sources in percent of all credits taken (n=93)

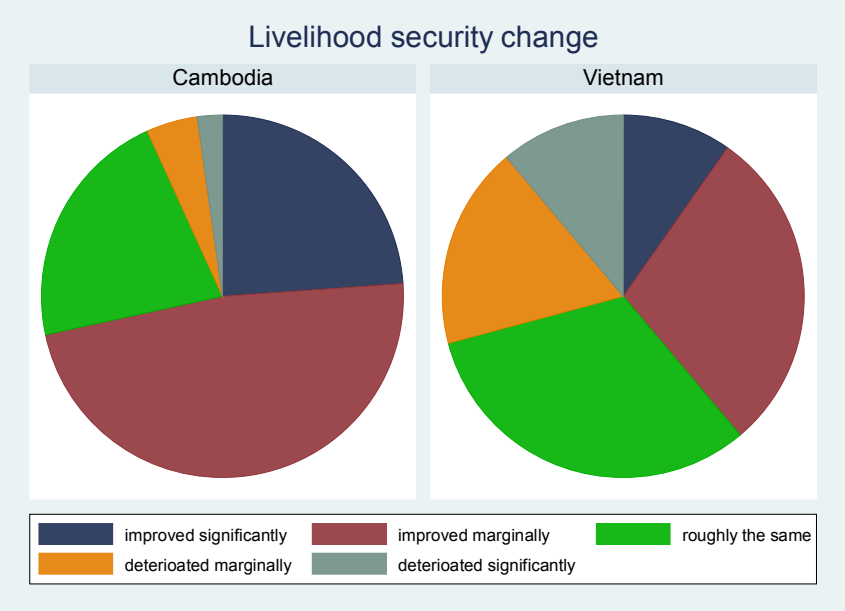

Figure 71: HH livelihood security change over the last five years

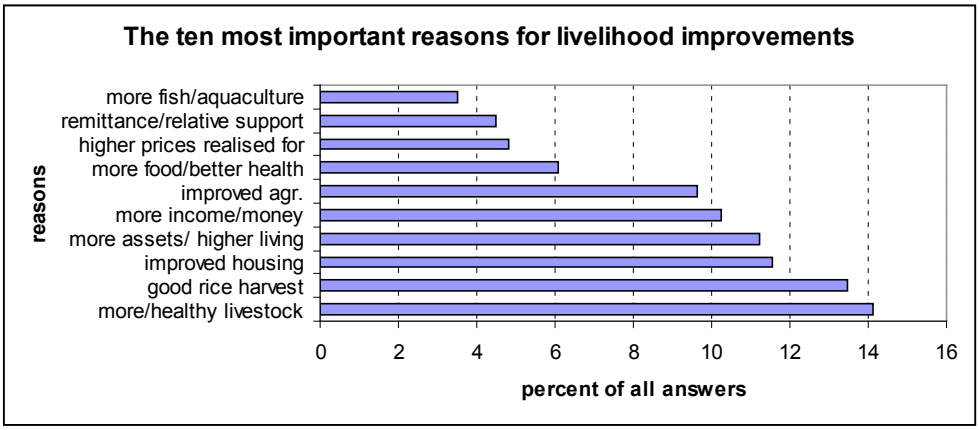

Figure 72: Ten most often mentioned reasons for livelihood improvement in the last five years (n=312)

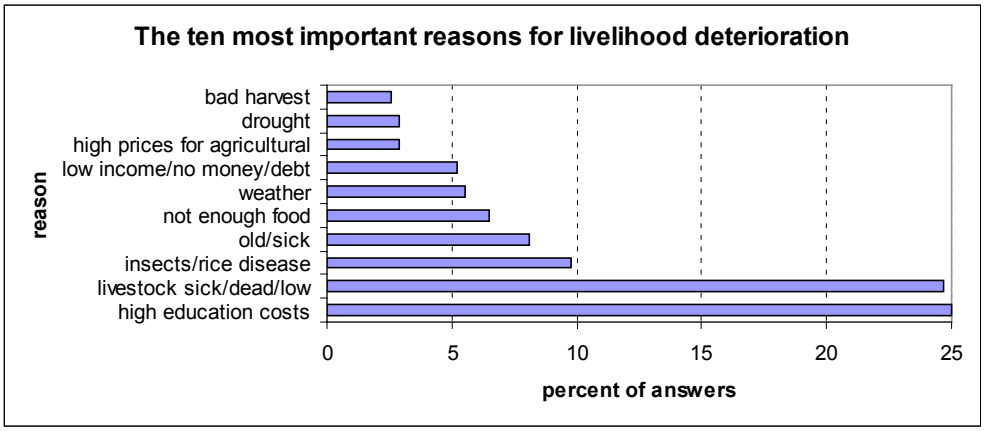

Figure 73: Ten most often mentioned reasons for livelihood deterioration in the last five years (n=308)

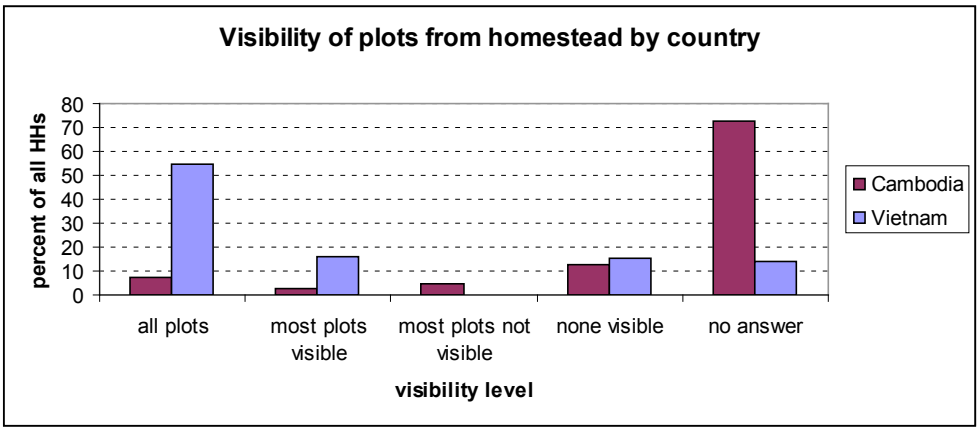

Figure 74: Visibility of crop lands by country

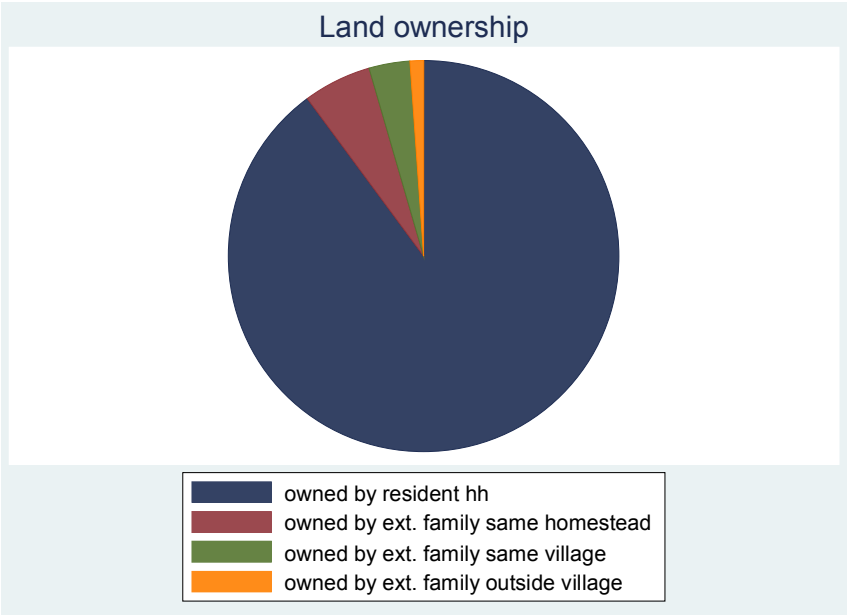

Figure 75: Land ownership

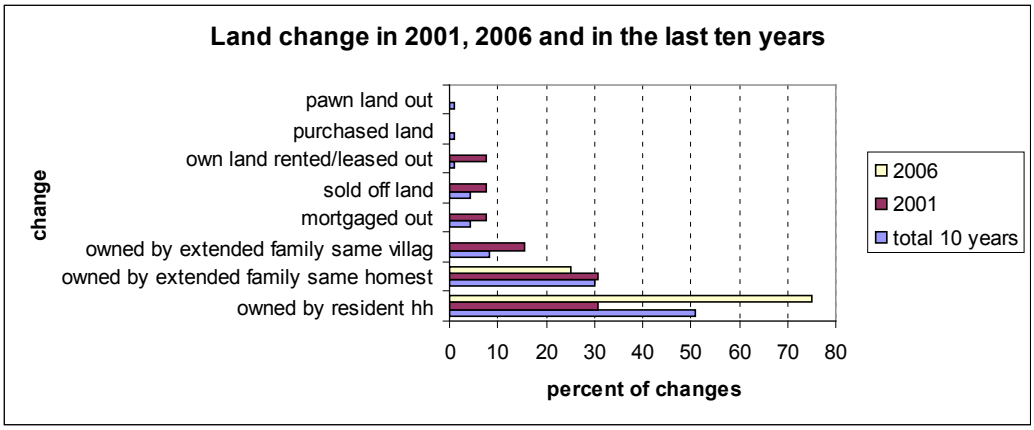

Figure 76: Changes of land title in 2001, 2006 and total over (1996-2006)

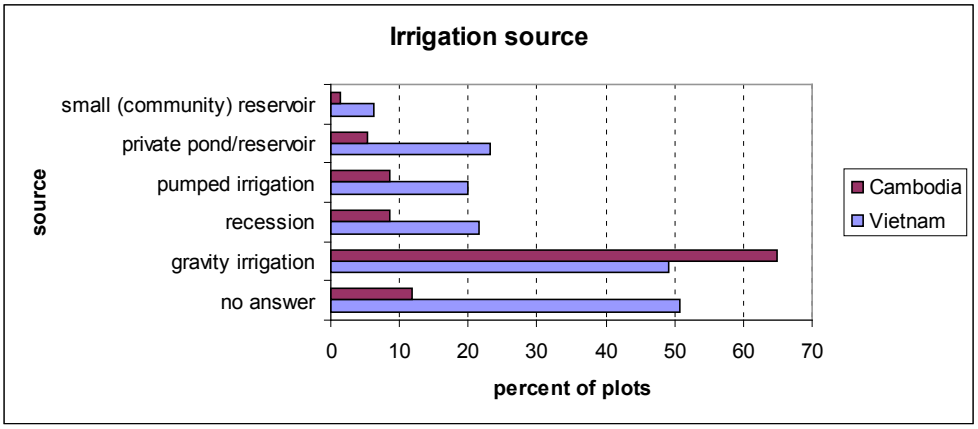

Figure 77: Irrigations source by country

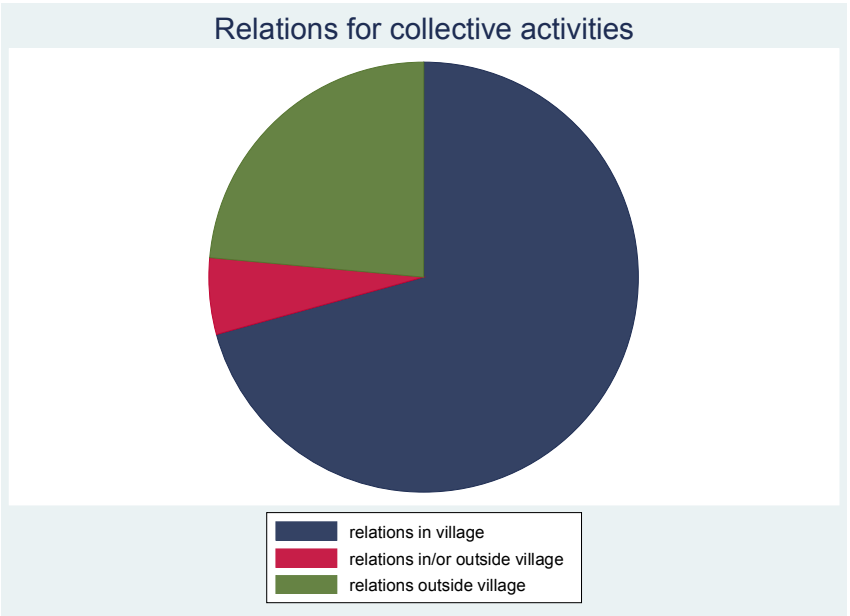

Figure 78: Relations for collective activities

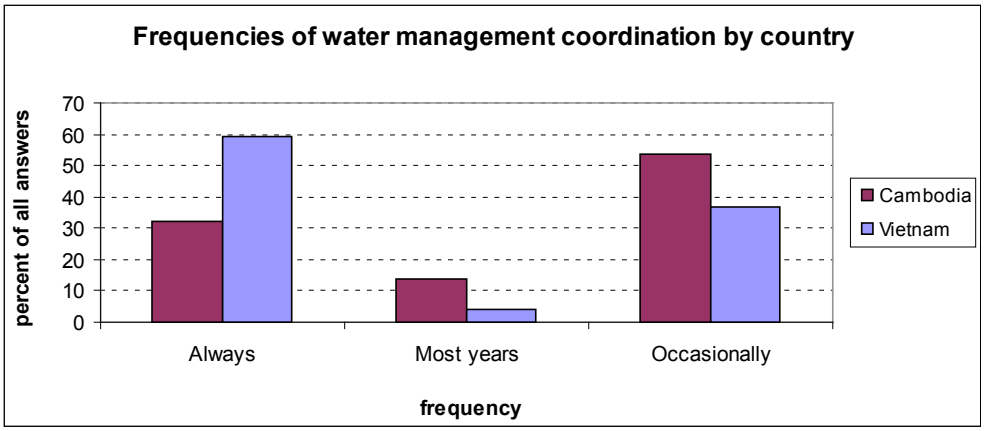

Figure 79: Frequency of water management coordination by country (n=222)

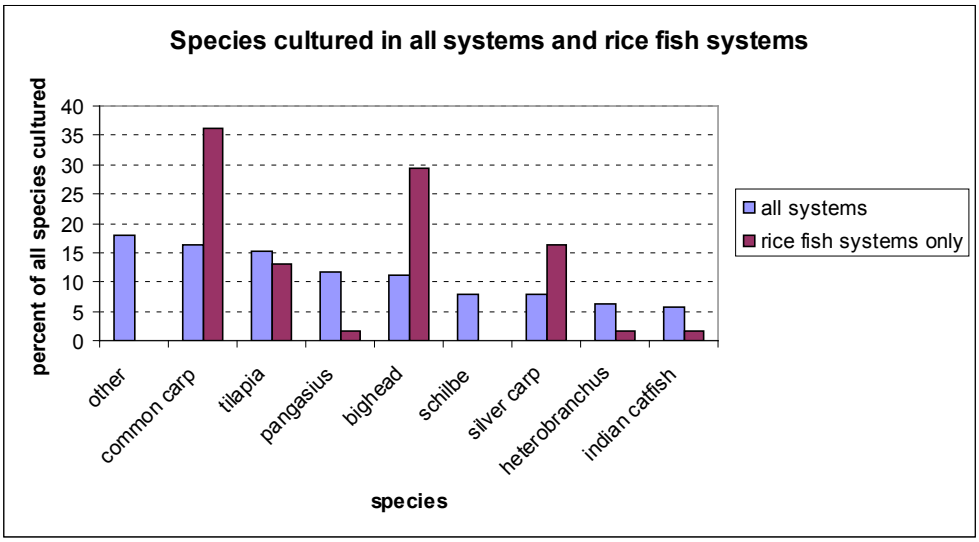

Figure 80: Species cultured in all systems

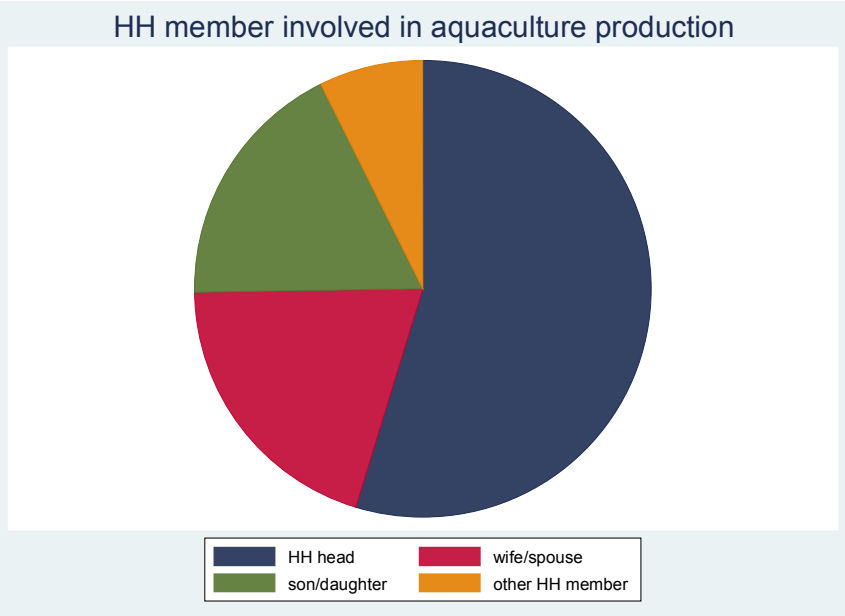

Figure 81: HH member involved in aquaculture production

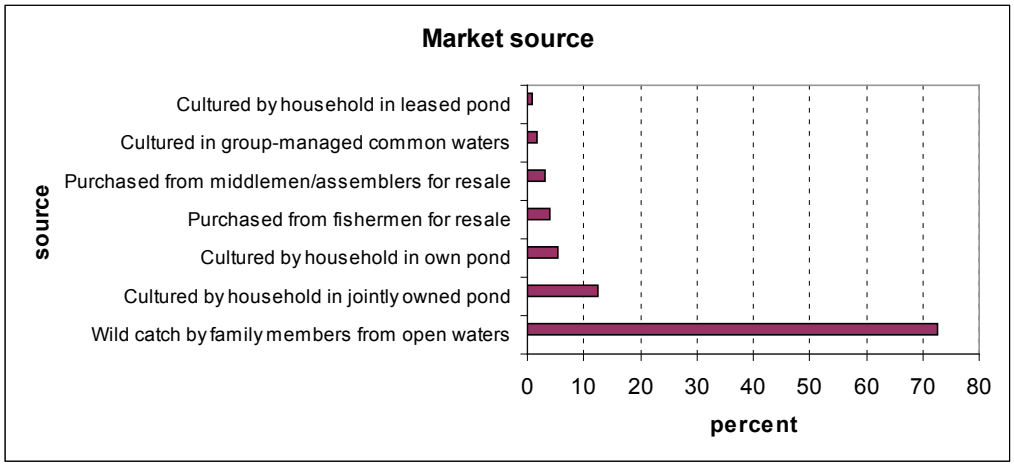

Figure 82: Market source of aquatic products for processing

Regression Tables

Model Survey	(S1)		(S2)		(S3)		(S4)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demographic								
Age	0.054***	0.014	0.051***	0.012	0.064***	0.015	0.053***	0.013
Male	0.834**	0.358	0.790***	0.282	0.736*	0.418	0.769***	0.290
Education (No. of yrs)	0.025	0.052			0.033	0.055		
HH head	-0.126	0.350			-0.159	0.373		
Married	1.122**	0.417	0.917**	0.437	1.614***	0.483	0.953**	0.445
Years living in village	-0.004	0.008			-0.004	0.008		
HH size	0.041	0.058			0.034	0.060		
Occupation								
Farming	-0.402	0.377			-0.566	0.359		
Fishing	-0.576	0.574			-0.586	0.553		
Aquaculture	1.030***	0.373	1.032***	0.344	1.043***	0.409	1.074***	0.357
Collective action								
Member of an organisation	1.600***	0.355	1.556***	0.335	1.878***	0.386	1.582***	0.348
Committee member	0.215	0.418			0.165	0.421		
HH specific data								
Remittance HH					-0.461	0.311		
Credit taken					-1.184**	0.425	-0.897**	0.380
Coll. water man.					0.285	0.304		
Poor HH					0.716	0.457		
Middle HH					0.161	0.343		
Landless HH					-0.489	0.549		
Land ownership					-0.057	0.585		
Pond ownership					0.330	0.499		
Controls								
Village dummies	2 villages		2 villages		3 villages, 1 significant		2 villages, 1 significant	
Country	0.980**	0.450	0.463	0.433	-6.745***	1.623	-6.610***	1.113
Constant	-7.230***	88.268	-6.821	1.090	252.485***	117.467	122.922*	66.824
Observations	560		560		560		560	
Pseudo R^2 (McFadden)	0.5133		0.5024		0.5509		0.5143	
Chi^2	75.14***		67.89***		81.29***		67.73***	
Count R^2	0.964		0.964		0.970		0.964	
Adj. Count R^2	0.231		0.231		0.346		0.231	
Model degree of freedom	15		8		23		9	
Log Likelihood	-51.204		-52.348		-47.243		-51.092	
Log Likelihood constant model only	-105.203		-105.203		-105.203		-105.203	
Pearson Chi^2	198.21		143.11		172.55		184.48	
Hosmer-Lemeshow Chi^2	0.60		0.64		0.36		0.39	

Table 25: Probit regression with *project member* as dependent variable (S1 & S2). Model S3 and S4 add further aggregated HH data.

Notes:

i) The estimator is MLS with Huber-White Heteroskedasticity-Consistent Standard Errors.

ii) The symbol ***, **, * indicate respectively a significance at a 1 %, 5 % and 10 % level.

iii) Reference categories of dummies that are not obvious: Poor HH, Middle HH: Better-off HH; Occupation: all other work.

Model Survey	(S5)		(S6)		(S7)		(S8)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Aggr. member data								
Mean Age					0.013	0.021		
Mean Education (No. of years)					0.019	0.069		
Occupations in HH								
Farming HH					0.009	0.597		
Fishing HH					-0.107	0.427		
Aquaculture HH					1.484***	0.437	1.342***	0.375
CA of members								
Member of an organisation					1.057**	0.412	0.914**	0.394
Committee member					0.499	0.460		
HH specific data								
Remittance HH	-0.085	0.272			-0.291	0.341		
Credit taken	-0.804**	0.377	-0.766**	0.369	-1.263***	0.435	-1.005***	0.363
Coll. water management	0.307	0.323			0.072	0.324		
Poor HH	-0.089	0.399			0.734	0.454		
Middle HH	-0.185	0.311			0.113	0.379		
Landless HH	-0.623	0.487			-1.015*	0.544	-0.750*	0.416
Land ownership	0.426	0.520			-0.183	0.433		
Pond ownership	0.717*	0.399	0.952**	0.389	-0.054	0.504		
Controls								
Village dummies	2 villages		2 villages, 1 significant		2 villages		2 villages	
Country	0.405	0.656	-0.212	0.503	-0.074	0.667	-0.039	0.509
Constant	1.391**	0.653	-1.038***	0.385	-2.606**	1.606	-1.781***	0.525
Observations	143		143		143		143	
Pseudo R^2 (McFadden)	0.1478		0.1120		0.3392		0.3014	
Chi^2	25.38**		23.85*		49.81***		42.76***	
Count R^2	0.832		0.825		0.860		0.774	
Adj. Count R^2	0.077		0.038		0.231		0.154	
Model degree of freedom	11		5		18		7	
Log Likelihood	-57.784		-60.211		-44.801		-47.366	
Log Likelihood constant model only	-67.802		-67.802		-67.802		-67.802	
Pearson Chi^2	61.2		2.98		112.52		8.17	
Hosmer-Lemeshow Chi^2	1.81		0.24		1.05		0.31	

Table 26: Probit regression with *project HH* as dependent variable (S6 & S7). Model S7 and S8 add further aggregated HH data.

Notes: see Table 25

Model PG game	(PG1)		(PG2)		(PG3)		(PG4)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demogr.								
Age	0.045	0.306			0.001	0.003		
Male	-3.913	10.652			-0.023	0.092		
Education (No. of years)	0.415	1.577			0.002	0.014		
HH head	-5.644	8.217			-0.058	0.070		
Married	-6.122	8.168			-0.032	0.066		
HH size	1.039	2.291			0.004	0.019		
Yrs. living in vill.	-0.284	0.288			-0.003	0.002		
Occupation								
Farmer	-14.222	12.288			-0.162	0.110		
Fisher	-4.518	14.496			-0.026	0.113		
Collective Action								
Organisational member	-3.666	12.965			-0.067	0.117		
Committee member	5.516	13.431			-0.025	0.126		
Time spent for coll. activities	0.123	0.133			0.001	0.001		
Experimental								
Understanding	0.226	11.498			0.014	0.096		
Real life application	17.692*	10.174	11.419*	6.559	0.126	0.090		
Project								
Experiences with the task	-0.214	13.594			0.000	0.106		
Controls								
Constant	180.562***	35.104	160.031***	4.648	5.331***	0.342	5.071***	0.028
Session Dummies	6 sessions (1 session significant)		1 session (significant)		6 sessions (1 session significant		1 session (significant)	
No. of observations	124		124		124		124	
R^2	0.244		0.170		0.233		0.143	
Adj. R^2	0.0881		0.130		0.0746		0.116	
S.E. of regression	37.17		35.75		0.328		0.317	
Joint test all variables	F=1.458		F=10.58***		F=1.171		F=9.904***	
Heteroskedasticity test (Breusch-Pagan)	chi^2=22.31***		chi^2=5.24**		chi^2=14.77***		chi^2=2.49	
Ramsey RESET test (3 fitted values)	F=3.18**		F=7.74**		F=6.84***		-	
Testing exclusion restriction			F=0.60				F=0.51	

Table 27: OLS regression of cooperation in the PG game. Model PG1 and PG2 use *cooperation* as dependent variable, Model PG3 and PG4 the *natural logarithm of cooperation* as dependent variable.[274]

Notes:

i) The estimator is OLS with Huber-White Heteroskedasticity-Consistent Standard Errors.

ii) The symbol ***, **, * indicate respectively a significance at a 1 %, 5 % and 10 % level.

iii) Reference categories of dummies that are not obvious: Occupation: all other work.

[274] As the natural logarithm of zero is not defined, values with zero have been replaced with zero in the ln regressions in order to keep the amount of observations.

Model PG game	(PG5)		(PG6)		(PG7)		(PG8)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demogr.								
Age	-0.120	0.409			-0.000	0.001		
Male	1.451	8.376			0.003	0.025		
Education (No. of years)	2.834*	1.663	1.881*	1.054	0.008*	0.005	0.006**	0.003
HH head	11.729	7.817			0.036	0.023		
Married	-12.701	9.350			-0.037	0.027		
HH size	-1.322	2.213			-0.005	0.006		
Yrs. living in vill.	0.343	0.299			0.001	0.001		
Occupation								
Farmer	24.404**	11.161	27.788***	10.515	0.072**	0.033	0.091***	0.033
Fisher	42.006***	14.330	27.022***	8.453	0.126***	0.042	0.076***	0.025
Collective Action								
Organisational member	-1.175	13.350			-0.004	0.038		
Committee member	2.965	12.675			0.008	0.036		
Time spent for coll. activities	0.063	0.141			0.000	0.000		
Experimental								
Understanding	9.095	9.878			0.027	0.029		
Real life application	-9.521	9.367			-0.028	0.027		
Project								
Experiences with the task	4.079	13.317			0.012	0.037		
Controls								
Constant	329.727***	31.435	326.302***	11.429	5.795***	0.088	5.776***	0.035
Session Dummies	6 sessions		-		6 sessions (1 session significant)		1 session	
No. of observations	124		124		124		124	
R^2	0.236		0.101		0.253		0.118	
Adj. R^2	0.0792		0.0781		0.0992		0.0885	
S.E. of regression	37.68		37.70		0.109		0.110	
Joint test all variables	F=1.695**		F=5.442***		F=1.638**		F=4.510***	
Heteroskedasticity test (Breusch-Pagan)	chi^2=4.28**		chi^2=2.53		chi^2=10.13***		chi^2=6.22**	
Ramsey RESET test (3 fitted values)	F=1.20		F=0.82		F=1.78		F=0.61	
Testing exclusion restriction			F=1.24				F=1.14	

Table 28: OLS regression of payoff in the PG game. Model PG5 and PG6 use *payoff* as dependent variable, Model PG7 and PG8 the *natural logarithm of payoff* as dependent variable.[275]

Notes: see Table 27

[275] See Footnote Table 27

Model CPR game	(CPR1)		(CPR2)		(CPR3)		(CPR4)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demogr.								
Age	0.018	0.612			0.004	0.013		
Male	-29.542**	12.207	-30.273**	12.080	-0.573*	0.290	-0.502**	0.242
Education (No. of years)	-0.432	2.195			0.012	0.046		
HH head	-16.582	10.743			-0.585***	0.218	-0.429**	0.173
Married	18.763	11.862			0.254	0.246		
HH size	-2.286	2.790			-0.046	0.065		
Yrs. living in vill.	0.447	0.605			0.009	0.012		
Occupation								
Farmer	-17.457	15.710			-0.390	0.380		
Fisher	21.145	19.009			0.552*	0.328	0.559*	0.318
Collective Action								
Organisational member	21.490	35.495			0.871	0.986		
Committee member	-3.909	12.491			-0.257	0.276		
Time spent for coll. activities	-0.470*	0.243	-0.438*	0.264	-0.009*	0.005	-0.010	0.006
Experimental								
Understanding	10.843	11.761			-0.066	0.286		
Real life application	14.549	13.264			0.278	0.299		
Project								
Experiences with the task	86.100***	19.381	76.732***	11.162	1.066**	0.419	0.935***	0.200
Controls								
Constant	83.640*	48.873	116.873***	6.555	3.730***	1.323	4.722***	0.114
Session Dummies	6 sessions (1 session significant)		1 session		6 sessions		-	
No. of observations	127		127		127		127	
R^2	0.398		0.310		0.290		0.190	
Adj. R^2	0.277		0.287		0.148		0.157	
S.E. of regression	57.41		57.00		1.306		1.299	
Joint test all variables	F=4.4***		F=17.62***		F=1.69**		F=6.63***	
Heteroskedasticity test (Breusch-Pagan)	chi^2=4.29**		chi^2=5.69**		chi^2=18.49***		chi^2=14.08***	
Ramsey RESET test (3 fitted values)	F=4.8***		F=1.74		F=9.27***		F=2.34*	
Testing exclusion restriction			F=1.28				F=1.08	

Table 29: OLS regression of cooperation in the CPR game. Model CPR1 and CPR2 use *cooperation* as dependent variable, Model CPR3 and CPR4 the *natural logarithm of cooperation* as dependent variable.[276]

Notes:

i) The estimator is OLS with Huber-White Heteroskedasticity-Consistent Standard Errors.
ii) The symbol ***, **, * indicate respectively a significance at a 1 %, 5 % and 10 % level.
iii) Reference categories of dummies that are not obvious: Occupation: all other work.

[276] See Footnote Table 27

Model CPR game	(CPR5)		(CPR6)		(CPR7)		(CPR8)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demogr.								
Age	-1.463**	0.634	-1.147**	0.559	-0.006**	0.003	-0.005**	0.003
Male	11.136	14.378			0.040	0.060		
Education (No. of years)	0.750	2.093			0.004	0.008		
HH head	14.437	12.671			0.045	0.050		
Married	1.372	12.254			-0.015	0.051		
HH size	1.449	2.575			0.005	0.011		
Yrs. living in vill.	1.669***	0.636	1.362**	0.540	0.007**	0.003	0.006**	0.003
Occupation								
Farmer	-17.928	16.905			-0.072	0.072		
Fisher	-22.993	36.609			-0.092	0.152		
Collective Action								
Organisational member	-41.618	31.623			-0.164	0.114		
Committee member	7.325	11.970			0.017	0.049		
Time spent for coll. activities	0.006	0.242			0.000	0.001		
Experimental								
Understanding	-15.305	16.853			-0.064	0.063		
Real life application	10.475	12.225			0.029	0.048		
Project								
Experiences with the task	96.147***	24.167	102.036***	9.244	0.349***	0.089	0.366***	0.036
Controls								
Constant	310.731***	45.871	264.293***	16.968	5.727***	0.187	5.542***	0.067
Session Dummies	6 sessions		-		6 sessions			
No. of observations	127		127		127		127	
R^2	0.438		0.367		0.390		0.327	
Adj. R^2	0.325		0.351		0.267		0.311	
S.E. of regression	62.37		61.16		0.253		0.245	
Joint test all variables	7.081***		41.48***		6.258***		36.55***	
Heteroskedasticity test (Breusch-Pagan)	chi^2=10.72***		chi^2=16.76***		chi^2=17.79***		chi^2=20.40***	
Ramsey RESET test (3 fitted values)	F= 4.95***		F=0.09		F=3.94***		F=0.26	
Testing exclusion restriction			F=0.91				F= 0.79	

Table 30: OLS regression of payoff CPR game. Model CPR5 and CPR6 use *payoff* as dependent variable, Model CPR7 and CPR8 the *natural logarithm of payoff* as dependent variable.[277]

Notes: see Table 29

[277] See Footnote Table 27

Model trust game	(TG1)		(TG2)		(TG3)		(TG4)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Socio-demogr.								
Age	0.012	0.009			0.005	0.004		
Male	-0.099	0.140			-0.020	0.063		
Education (No. of years)	0.037*	0.022	0.039**	0.016	0.015	0.009		
HH head	-0.065	0.171			-0.036	0.078		
Married	0.282	0.177			0.102	0.088		
HH size	-0.044	0.036			-0.017	0.015		
Yrs. living in village	-0.008	0.008			-0.003	0.004		
Occupation								
Farmer	-0.107	0.219			-0.066	0.098		
Fisher	-0.014	0.241			0.048	0.101		
Collective Action								
Member of org.	-0.077	0.184			-0.005	0.072		
Committee member	-1.177***	0.357	-1.345***	0.250	-0.479***	0.156	-0.544***	0.124
Time spent for CA	-0.003	0.002			-0.001	0.001		
Experimental								
Understanding	0.104	0.170			0.028	0.073		
Real life appl.	-0.421**	0.197	-0.294**	0.145	-0.133*	0.079	-0.108*	0.063
Motives								
M1	-0.124	0.266			0.031	0.110		
M2	-0.705***	0.250	-0.497***	0.183	-0.338***	0.124	-0.285***	0.092
M3	0.796***	0.176	0.767***	0.144	0.331***	0.075	0.368***	0.062
M4	0.048	0.204			-0.020	0.089		
M5	0.866***	0.202	0.783***	0.162	0.369***	0.087	0.357***	0.072
Project village	1.376***	0.431	1.541***	0.212	0.634***	0.188	0.712***	0.095
Controls								
Constant	1.736***	0.402	1.605***	0.227	0.433**	0.198	0.406***	0.103
Session dummies	5 sessions (2 sessions significant)		2 sessions (2 significant)		5 sessions (2 sessions significant)		2 sessions (2 significant)	
No. of observations	117		117		117		117	
R^2	0.820		0.795		0.796		0.770	
Adj. R^2	0.771		0.778		0.740		0.753	
S.E. of regression	0.712		0.701		0.310		0.303	
Joint test all variables	52.24***		124.0***		57.76***		290.3***	
Heteroskedasticity test (Breusch-Pagan)	chi^2=0.68		chi^2=1.96		chi^2=1.56		chi^2=2.49	
Ramsey RESET test (3 fitted values)	F =4.11***		F=1.35		F=7.89***		F=1.69	
Testing exclusion restriction			F=1.66**				F=1.02	

Table 31: OLS regression of amount sent. Model TG1 and TG2 use *amount sent* as dependent variable, Model TG3 and TG4 the *natural logarithm of amount sent* as dependent variable.[278]

i) The estimator is OLS with Huber-White Heteroskedasticity-Consistent Standard Errors.
ii) The symbol ***, **, * indicate respectively a significance at a 1 %, 5 % and 10 % level.
iii) Reference categories of dummies that are not obvious: Poor HH, Middle HH: Better-off HH; Occupation: all other work.

[278] See Footnote Table 27

Model trust game	(TG5)		(TG6)		(TG7)		(TG8)	
Variables	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Offer	0.007	0.043			-0.142**	0.064	0.071	0.061
Socio-demogr.								
Age	0.002	0.003			0.000	0.007		
Male	0.096*	0.054	0.137**	0.052	0.058	0.092		
Education (No. of years)	-0.003	0.010			0.014	0.020		
HH head	0.030	0.054			0.138	0.104		
Married	0.076	0.067			0.242*	0.137	0.164	0.159
HH size	0.000	0.018			0.008	0.028		
Yrs. living in village	0.002	0.003			-0.000	0.007		
Occupation								
Farmer	0.067	0.086			0.207	0.170		
Fisher	0.147	0.132			0.018	0.204		
Collective Action								
Member of org.	0.016	0.061			-0.009	0.101		
Committee member	-0.070	0.190			-0.584	0.530		
Time spent for CA	0.000	0.000			-0.000	0.000		
Experimental								
Understanding	-0.075	0.059			-0.125	0.132		
Real life appl.	-0.038	0.074			-0.074	0.140		
Motives								
M1	0.105	0.090			0.319	0.209		
M2	0.096	0.108			0.295	0.201		
M3	-0.042	0.092			-0.187	0.149		
M4	-0.039	0.090			0.002	0.148		
M5	-0.216	0.167			-0.131	0.209		
Project village	0.416**	0.177	0.181***	0.059	1.056***	0.280	-0.182	0.172
Controls								
Constant	0.005	0.225	0.324***	0.054	-1.161***	0.403	-0.837***	0.168
Session dummies	6 sessions (1 session significant)		1 session		6 sessions (2 significant)		2 sessions	
No. of observations	96		96		96		96	
R^2	0.466		0.163		0.451		0.068	
Adj. R^2	0.254		0.135		0.234		0.0159	
S.E. of regression	0.235		0.253		0.447		0.507	
Joint test all variables	3.743***		5.060***		4.458***		1.046	
Heteroskedasticity test (Breusch-Pagan)	chi^2= 1.55		chi^2=0.09		chi^2=2.24		chi^2=0.37	
Ramsey RESET test (3 fitted values)	F=1.31		F=0.17		F=2.95**		F=2.69**	
Testing exclusion restriction			F=3.25***				F=4.86***	

Table 32: OLS regression of return ratio. Model TG5 and TG6 use *return ratio* as dependent variable, Model TG7 and TG8 the *natural logarithm of return ratio* as dependent variable.[279]

Notes: see Table 31

[279] See Footnote Table 27